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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART VIII.—Missouri River Drainage

BY

CYRUS C. BABB, M. C. HINDERLIDER, and JOHN C. HOYT

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART VIII.

By C. C. Babb, M. C. Hinderlider, and J. C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or the great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys, fiscal years ending June 30, 1895-1906.

1895	$12,500	1901	100,000
1896	30,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical

purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern. and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, so far as practicable, geographically.

List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

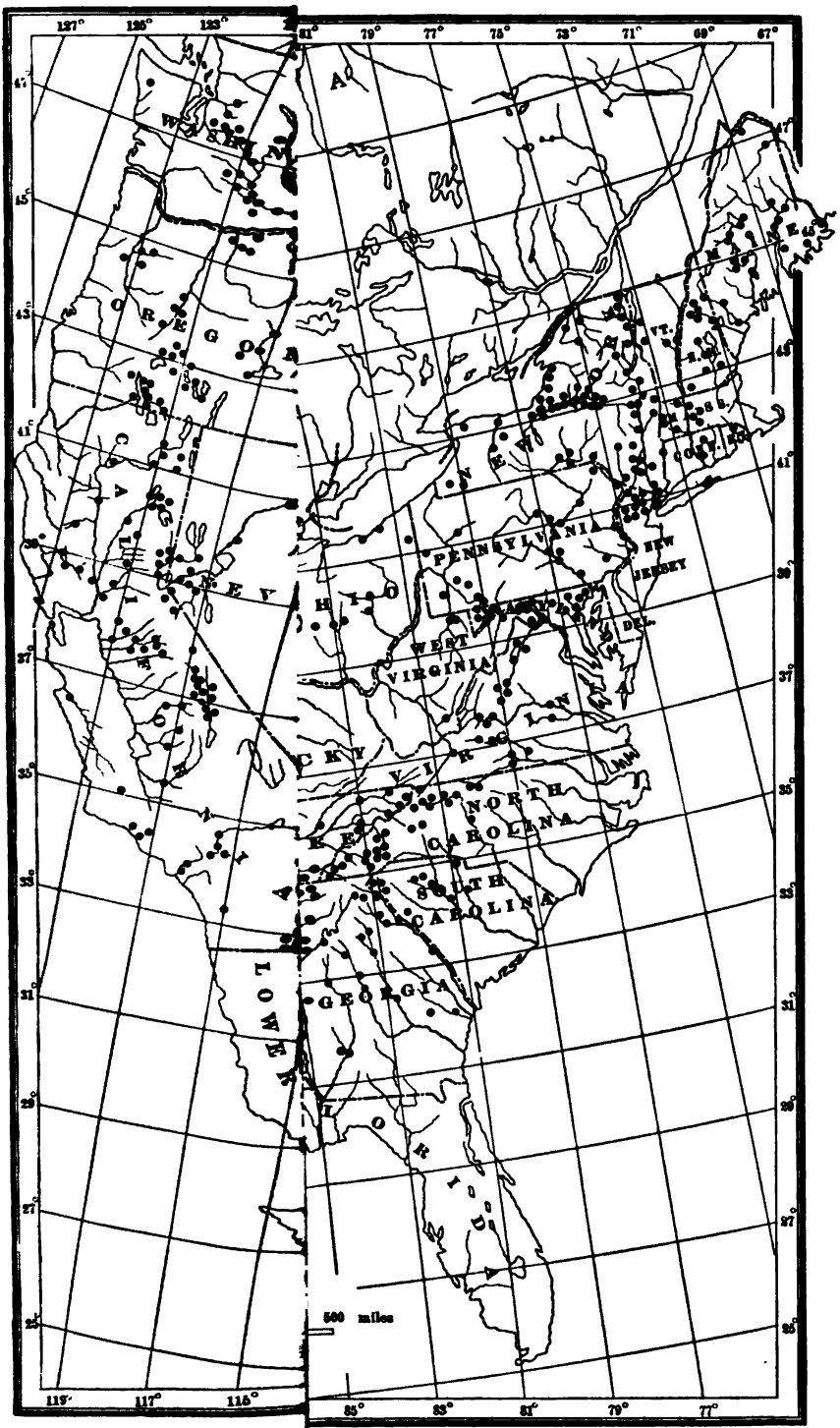
St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor southern Atlantic.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor eastern Gulf of Mexico.
Mobile.	


127°
125°
123°
81°
79°
77°
75°
73°
71°
69°
67°
47°
45°
43°
41°
39°
37°
35°
33°
31°
29°
27°
25°
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
NEW MEXICO
COLORADO
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
NEW JERSEY
DEL.
MD.
VT.
N. H.
MAINE
500 miles
119°
117°
115°
85°
83°
81°
79°
77°

DURING 1905.

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. This is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined on page 3.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as closely as the data on which they are based will warrant No decimals are to be used when the discharge is over 50 second-feet.
2. Daily discharges shall be applied directly to the gage heights as they are tabulated.
3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.
4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125, .012, .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimals places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, or 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equals 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.

1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.
To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = Net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3 l}$ = length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1 : 125000, 1 mile=0.50688 inch.
Scale 1 : 90000, 1 mile=0.70400 inch.
Scale 1 : 62500, 1 mile=1.01376 inches.
Scale 1 : 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{r\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q = c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water must be measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted

should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, by a current meter, or by a simple system of water wheels which are of standard make or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

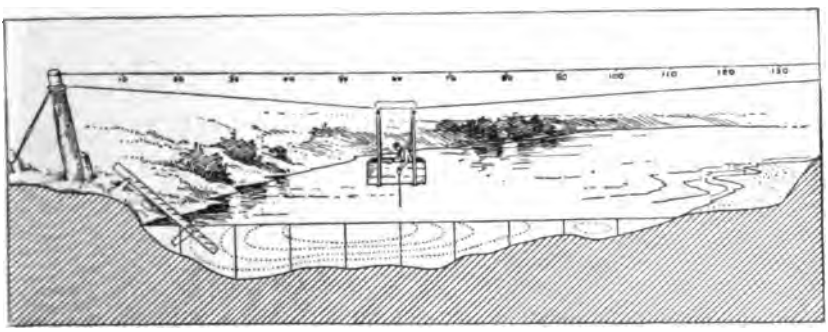


FIG. 1.—Cable station, showing section of river, car, gage, etc.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same, whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally appurtenant to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them observations can more readily be made and the cost of equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory

surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In all surface float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the area at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, or boat or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete

measurement by this method its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is based on the assumption that the vertical velocity-curve is a common parabola, in which the mean ordinate equals the mean of the ordinates at 0.2211 depth and at 0.7886 depth. Actual observations show that this law holds very closely.

In the third multiple-point method the meter is held at mid depth at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing the mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be unaffected by the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to the lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141-148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads, and the rating table considered.

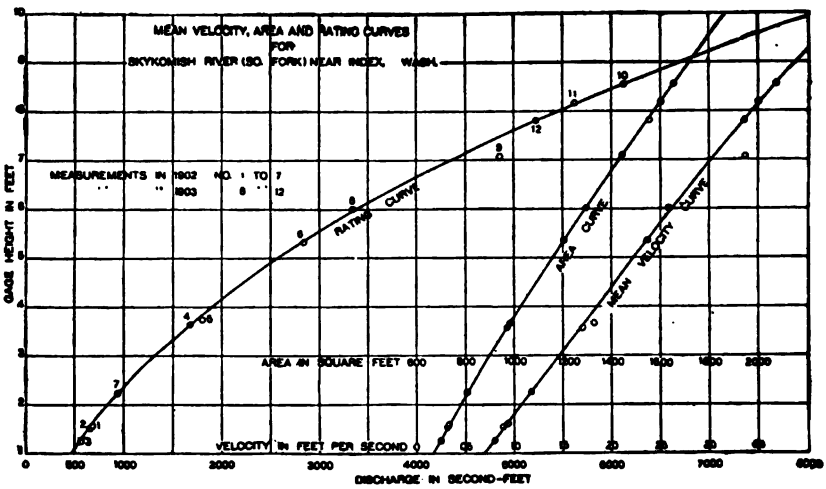


FIG. 2. -Discharge, mean-velocity, and area curves for South Fork of Skykomish River near Index, Wash.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage, if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be therefore a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity-curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height, or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, page 323, and in Engineering News of April 21, 1904. This method, or a graphic application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted these hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged geographically by States, gives the names of the hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Colorado.—District and resident hydrographer, M. C. Hinderlider,[a] assisted by R. I. Meeker, Wm. A. Lamb, A. A. Welland, Melvin Beeson, Thomas E. Brick, and F. L. Meeker. Acknowledgments are due the Colorado and Southern, Burlington and Missouri River, Union Pacific, and Chicago, Burlington and Quincy railroads for transportation furnished the district and local hydrographers.

[a] Office of district hydrographer for Colorado, Kansas, northern New Mexico, and southern Wyoming, Chamber of Commerce Building, Denver, Colo.

Kansas.—District hydrographer, M. C. Hinderlider; resident hydrographer, W. G. Russell. Acknowledgments are due the Atchison, Topeka and Santa Fe, Union Pacific, Missouri, Kansas and Texas, Missouri Pacific, and Chicago, Rock Island and Pacific railways for annual passes issued to Mr. Russell.

Missouri.—District hydrographer, F. W. Hanna,[a] assisted by M. S. Brennan and S. K. Clapp. Acknowledgment is due the St. Louis and San Francisco Railroad for transportation furnished to Messrs. Hanna and Brennan.

Nebraska.—District hydrographer, M. C. Hinderlider [b] assisted by J. C. Stevens and by H. C. Gardner. and F. S. Dobson, assistants to the State engineer. Valuable assistance was rendered by Prof. O. V. P. Stout, of the University of Nebraska, in the way of free use by J. C. Stevens of office facilities and suggestions in the methods for the collection of field data. Acknowledgments are also due the Chicago, Burlington and Quincy, Chicago and Northwestern, and Fremont, Elkhorn and Missouri Valley railroads for annual passes issued in favor of Messrs. Stevens and Gardner.

Montana.—District engineer, C. C. Babb,[c] assisted by C. T. Prall, L. R. Stockman, H. M. Morse, W. B. Freeman, J. H. Sloan, A. P. Porter, and Gordon Edson. Acknowledgments are due the Great Northern and Northern Pacific railways for transportation and to Mr. J. W. Shields, of Choteau, Mont., for voluntary observations of Teton River.

North Dakota.—District hydrographer, F. W. Hanna, assisted by E. F. Chandler, of the engineering department of the University of North Dakota.

South Dakota.—Resident hydrographer, R. F. Walter.[d]

Wyoming.—The hydrographic work in the State has been carried on under the direction of the district hydrographer, M. C. Hinderlider, and by the resident hydrographer, A. J. Parshall. Acknowledgments are due for annual passes over all their lines in Wyoming to the Union Pacific, Chicago, Burlington and Quincy, Colorado and Southern, Colorado and Wyoming, and Fremont, Elkhorn and Missouri Valley railroads.

GENERAL FEATURES OF THE MISSOURI RIVER DRAINAGE.

Missouri River and its innumerable tributaries drain an immense area in the northern and western section of the United States. The northern boundary of this area is approximately the fiftieth parallel, the southern the thirty-ninth; its western limit is the Rocky Mountain region, while to the east the divide between this basin and that of the upper Mississippi crosses eastern North and South Dakota, western Iowa, and northeastern Missouri. Its extent east and west is about 900 miles; north and south it is 600 miles; the basin comprises a total of 492,000 square miles.

The topography of the basin is of the most varied character, ranging from the mountainous regions of Montana, Wyoming, and Colorado to the rolling prairies of the Dakotas, Nebraska, and Kansas. The upper tributaries drain a forested region, but the main stream flows through a country almost wholly devoid of forests. The precipitation in the mountainous portion of the basin is mainly in the form of heavy snowfall, but a great part of the area lies within the arid and semiarid regions, and it is probable that the average annual precipitation throughout the entire basin is less than 20 inches.

The tributaries are mostly in the upper course of the river and from the western side of the basin. The most important of these tributaries are Mussellshell, Marias, Milk, Yellowstone, Cheyenne, Platte, and Kansas rivers.

The work of the United States Geological Survey in this drainage area during 1905 is set forth in the following pages:

MISSOURI RIVER.

DESCRIPTION OF BASIN.

Missouri River proper is formed in southwestern Montana by the union of three streams which were discovered by Lewis and Clark in 1806 and named by them Jefferson, Madison, and Gallatin rivers. Jefferson and Madison forks come together first, and within 2 miles they are joined by the Gallatin. The head of the Missouri thus formed lies in about latitude 45° 56′ north and longitude 111° 32′ west. Each of the three headwater rivers is about 90

[a] District hydrographer for Missouri during 1906, A. H. Horton, 876 Federal Building, Chicago, Ill.
[b] District hydrographer for 1906, Adna Dobson, State engineer, Lincoln, Nebr.
[c] District hydrographer for Montana, northwestern Minnesota, North Dakota, and northern Wyoming, 1906, H. M. Morse, Huntley, Mont.
[d] District hydrographer for 1906, J. E. Stewart, Belle Fourche, S. Dak.

feet wide, flows with great velocity, and discharges large quantities of water. The Gallatin is the most rapid of the three. The beds of all are formed of smooth pebbles and gravel and the waters are perfectly transparent.

From the junction of the three forks the course of the Missouri lies through mountain valleys and deep canyons, from which it finally issues through a gorge in a range of rocks, called by Lewis and Clark the "gates of the Rocky Mountains." Thirty-five miles above Fort Benton the river pours over Great Falls and from that point onward it is a navigable stream. For miles below the falls the river flows in a deep canyon, with banks ranging from 100 to 160 feet in height. Below the mouth of Marias River, which enters from the north, the banks are less abrupt and rise with gentle slopes to the bluffs. The high-water width of the river, which in the vicinity of Fort Benton is 500 to 1,000 feet, increases to 1,500 feet at the mouth of Milk River and to 2,000 feet near the mouth of the Yellowstone. Below the Yellowstone the width gradually increases from 2,000 to 3,000 feet, and this remains approximately the average width for 600 miles of its course.

From the mouth of the Yellowstone the Missouri follows a winding but on the whole southeasterly course until it is joined by the Kansas; thence it flows more to the east across the State of Missouri, and empties into the Mississippi 16 miles above St. Louis, 189 miles above the mouth of the Ohio, and 2,824 miles below the junction of its three upper forks.

For the first 350 miles below the union of the three forks the Missouri is a comparatively clear stream, but approximately midway between the forks and the mouth of the Yellowstone its character gradually changes and it becomes turbid. Although a large amount of the sediment carried by the Missouri is undoubtedly brought in by the drainage of its tributaries, the greater part is derived from the caving of its banks.

The volume of the Missouri is subject to great variations, the ordinary high-water discharge at the mouth being about 28 times the low-water discharge. The freshets are caused by melting snow and heavy summer rains. The amount of snow falling on the prairies is usually small, but among the Rocky Mountains the snows begin early, continue late, and accumulate to great depths. The regular floods occur in May and June, the June rise being as a rule higher and lasting longer. Thereafter the river steadily decreases in volume, the minimum being reached during the winter months.

Except in the mountain canyons the Missouri flows through an alluvial bottom land of the most fertile character, varying in width from 1½ miles near the mouth to 17 miles in the vicinity of Sioux City. Through this flood plain the river winds back and forth, leaving tongues of land alternately on either side, stretching out from one bluff to within a few thousand feet of the other. In the vicinity of St. Joseph the Missouri is said to make eight complete crossings within a distance of 30 miles, measured in the direction of its general course.

Irrigation is practiced on various tributaries of the stream and agriculture has been extensively developed in several of the valleys. The Missouri itself has not been used for irrigation, owing to its high banks and the consequent difficulty of diversion.

Information in regard to this basin is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: Ann 11, ii, pp 42-43; 12, ii, pp 236-237; 13, iii, pp 34-35; 22, iv, p 280; WS 84, pp 13-14; 99, pp 34-36; 130, pp 68-69.
Irrigation surveys in, engineering features: Ann 11, ii, pp 114-133; 13, iii, pp 34-63, 53-54.
Rainfall data: Ann 13, iii, pp 39-41; 20, iv, p 235; WS 75, pp 114-116.
Rainfall and run-off relation: Ann 20, iv, pp 232-235; WS 75, pp 117-118.

JEFFERSON RIVER NEAR SAPPINGTON, MONT.

This station was established November 13, 1894, and was discontinued December 31, 1905. It is located 1 mile north of the railroad station at Sappington, Mont., and 7 miles above Willow Creek.

The channel is straight for 500 feet above and below the station. Both banks are composed of clay and are covered with willows and underbrush; the right bank may overflow at extremely high water. The bed is smooth and regular and is covered with gravel. The current is swift and entirely free from eddies. The section is an excellent one.

Until June 15, 1904, discharge measurements were made by means of a cable situated about 300 feet above the old wooden bridge of the Northern Pacific Railway. On that date the cable station was destroyed and for a time measurements were made from the lower side of the railroad bridge. The new cable put in November 1, 1904, was placed about 500 feet above the old one, on account of the building of a new railroad bridge at the former site.

During 1905 the gage was read twice daily up to April 1 by John Fraser and from April 1 to November 11 by L. T. Hare, the agent of the Northern Pacific Railway at Sappington; after the latter date observations were taken once each day. The original gage was a vertical staff fastened to the middle pier of the Northern Pacific Railway bridge. November 3, 1897, the gage datum was lowered 0.80 foot. Readings for the subsequent years were adjusted to the new datum, but those for the rest of 1897 were corrected to agree with the old datum. Later a chain gage was fastened to the upstream side of the old railroad bridge; the length of the chain was 16.30 feet. June 14, 1905, the gage was moved to the downstream side of the new railroad bridge, 200 feet above; the new chain length is 24.31 feet. The same datum was used for the new gage, and as the water surface is 0.03 foot higher at this point, there was an increase of 0.03 foot in the gage readings. All readings, however, have been referred to the old datum. Bench marks Nos. 1, 2, and 3 are unreliable and two additional bench marks have been established, as follows: (4) A cross on top of the coping at the northwest corner of a small concrete culvert 800 feet east of the old railroad bridge; elevation, 11.57 feet. (5) A flat notch cut in the sloping surface on the lower wing wall of the east abutment of the Northern Pacific Railway bridge, about 4 feet from the lower corner, marked "U. S. G. S. B. M.;" elevation, 11.62 feet. Elevations are above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; Bull = Bulletin; WS = Water-Supply Paper):

Description: Ann 18, iv, pp 134–135; 19, iv, p 281; Bull 131, p 22; 140, pp 92–93; WS 15, pp 70–71; 27, p 68; 37, pp 206–207; 49, p 264; 66, p 19; 84, pp 47–48; 99, p 133; 130, pp 85–86.

Discharge: Ann 18, iv, p 135; Bull 131, pp 22, 92; 140, p 93; WS 15, p 71; 27, pp 74–75; 37, p 207; 49, p 264; 66, p 20; 84, p 48; 99, p 133; 130, p 86.

Discharge, monthly: Ann 18, iv, p 136; 19, iv, p 282; 20, iv, pp 234, 238; 22, iv, p 285; WS 75, pp 117, 120; 84, p 49; 99, p 135; 130, p 88.

Discharge, yearly: Ann 20, iv, p 53.

Gage heights: WS 11, p 49; 15, p 71; 27, p 71; 37, p 207; 49, p 264; 66, p 20; 84, p 48; 99, p 134; 130, p 87.

Hydrographs: Ann 19, iv, p 283; 20, iv, p 238; 22, iv, pp 286, 287; WS 75, p 120.

Rainfall and run-off relation: Ann 20, iv, p 235; WS 75, p 118.

Rating tables: Ann 18, iv, p 135; 19, iv, p 282; WS 27, p 75; 52, p 516; 66, p 170; 84, p 48; 99, p 134; 130, p 87.

Discharge measurements of Jefferson River near Sappington, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 3	L. R. Stockman	250	631	2.01	2.20	1,267
May 4	J. H. Sloan	250	705	2.06	2.32	1,454
May 19	do	250	581	2.11	2.05	1,224
June 14	do	252	1,172	3.52	4.02	4,122
July 8	do	255	887	2.38	2.82	2,112
August 4	do	248	558	1.76	1.92	983
September 7	do	237	377	1.56	1.50	588
September 21	do	247	363	1.33	1.37	484
October 27	H. M. Morse	250	583	1.99	2.15	1,159
November 16	J. H. Sloan	250	646	2.03	2.25	1,312

Daily gage height, in feet, of Jefferson River near Sappington, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.35	4.35	5.2	2.2	2.4	2.15	3.7	1.95	1.5	1.5	1.95	2.6
2	5.3	4.3	5.2	2.2	2.45	2.35	3.6	1.9	1.5	1.5	2.1	2.6
3	5.4	4.3	5.3	2.1	2.4	2.4	3.6	1.9	1.5	1.5	2.15	2.6
4	5.3	4.3	5.3	2.1	2.35	2.6	3.55	1.85	1.5	1.5	2.15	2.6
5	5.3	4.55	3.35	2.1	2.3	2.8	3.4	1.8	1.5	1.6	2.15	2.6
6	5.15	4.7	2.65	2.1	2.3	3.15	3.2	1.75	1.5	1.6	2.15	2.5
7	5.25	4.8	2.5	2.15	2.2	3.35	3.0	1.7	1.5	1.6	2.15	2.5
8	5.3	4.8	2.3	2.2	2.1	3.4	2.75	1.6	1.5	1.6	2.25	2.5
9	5.3	4.9	2.3	2.45	2.1	3.5	2.65	1.6	1.4	1.6	2.25	2.5
10	5.05	4.9	2.3	2.55	2.2	3.55	2.55	1.6	1.4	1.6	2.25	2.5
11	4.95	4.9	2.3	2.6	2.2	3.6	2.45	1.55	1.4	1.6	2.15	2.6
12	2.95	4.8	2.15	2.5	2.2	3.7	2.35	1.6	1.4	1.6	2.15	2.6
13	2.7	4.8	2.2	2.5	2.15	3.8	2.25	1.5	1.4	1.65	2.15	2.7
14	2.7	4.55	2.2	2.4	2.1	3.9	2.1	1.5	1.4	1.7	2.25	2.8
15	2.85	4.5	2.35	2.4	2.05	3.95	2.1	1.5	1.4	1.7	2.25	3.0
16	3.2	4.6	2.4	2.4	2.0	3.8	2.2	1.5	1.4	1.7	2.25	3.2
17	3.85	4.6	2.45	2.5	1.95	3.6	2.3	1.5	1.4	1.7	2.4	3.3
18	4.75	4.6	2.5	2.5	2.0	3.3	2.3	1.5	1.4	1.8	2.4	3.4
19	5.35	4.85	2.5	2.5	2.1	3.25	2.3	1.5	1.4	1.8	2.4	3.1
20	5.3	4.9	2.5	2.5	2.1	3.2	2.3	1.5	1.3	1.8	2.4	3.0
21	5.2	5.0	2.55	2.55	2.15	3.1	2.25	1.4	1.3	1.85	2.4	2.8
22	5.2	5.15	2.45	2.7	2.25	3.0	2.1	1.4	1.3	1.85	2.4	2.8
23	5.2	5.2	2.4	2.7	2.3	3.0	2.1	1.4	1.3	1.9	2.4	2.7
24	5.25	5.1	2.4	2.7	2.3	3.45	1.95	1.4	1.3	1.95	2.4	2.7
25	5.3	5.15	2.3	2.7	2.2	3.65	1.75	1.3	1.4	2.05	2.4	2.7
26	5.3	5.15	2.3	2.7	2.15	4.15	1.75	1.35	1.4	2.05	2.4	2.8
27	5.35	5.2	2.35	2.7	2.15	4.65	1.75	1.35	1.35	2.1	2.4	3.0
28	5.4	5.2	2.2	2.75	2.05	4.7	1.85	1.55	1.3	2.15	2.4	3.2
29	5.4	.....	2.2	2.6	2.1	4.45	2.0	1.6	1.35	2.05	2.5	3.3
30	5.4	.....	2.2	2.55	2.0	3.95	2.0	1.55	1.5	1.95	2.5	3.2
31	4.8	.....	2.2	.....	2.0	.....	2.0	1.5	.....	1.95	.....	3.0

NOTE.—River partly gorged January 1 to March 6; probably also gorged somewhat during December.

Station rating table for Jefferson River near Sappington, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	405	2.40	1,485	3.60	3,425	4.80	5,675
1.30	465	2.50	1,625	3.70	3,605	4.90	5,865
1.40	530	2.60	1,775	3.80	3,785	5.00	6,055
1.50	600	2.70	1,925	3.90	3,965	5.20	6,445
1.60	675	2.80	2,085	4.00	4,155	5.40	6,845
1.70	755	2.90	2,245	4.10	4,345	5.60	7,255
1.80	840	3.00	2,405	4.20	4,535	5.80	7,675
1.90	930	3.10	2,565	4.30	4,725	6.00	8,095
2.00	1,025	3.20	2,735	4.40	4,915	6.20	8,535
2.10	1,125	3.30	2,905	4.50	5,105	6.40	8,975
2.20	1,235	3.40	3,075	4.60	5,295		
2.30	1,355	3.50	3,245	4.70	5,485		

The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1904-5, and is well defined throughout.

Estimated monthly discharge of Jefferson River near Sappington, Mont., for 1905.

[Drainage area, 8,984 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 7-31	1,700	1,180	1,413	70,070	0.157	0.146
April	2,005	1,125	1,578	93,900	.176	.196
May	1,555	978	1,214	74,650	.135	.156
June	5,485	1,180	3,206	190,800	.357	.398
July	3,605	798	1,665	102,400	.185	.213
August	978	498	658	40,460	.073	.084
September	600	465	536	31,890	.060	.067
October	1,180	600	814	50,050	.091	.105
November	1,625	978	1,346	80,090	.150	.167
The period				734,300		

NOTE.—No estimate for ice period.

MADISON RIVER (INCLUDING CHERRY CREEK) NEAR NORRIS, MONT.

This station was established May 2, 1897, when the old station at Three Forks was discontinued. The gage is situated at Black's ranch, 12 miles north of Norris and 25 miles west of Bozeman; the measuring section is located at the point where the river emerges from the canyon, about 4 miles above the gage.

The channel is curved both above and below the measuring section, but the bridge is at a right angle to the current. Both banks are high and rocky and do not overflow. The bed of the stream is rocky and the current is swift.

Discharge measurements are made from the lower side of the steel highway bridge. The initial point for soundings is at the left abutment.

The gage at Black's ranch, which is observed twice daily by Mrs. S. A. Black, is a vertical rod fastened to a post firmly set in the bed of the river at the right bank and braced with cross-pieces from the bank. It is about 125 yards west of the house of the observer. The gage is referred to bench marks as follows: (1) Top of large granite bowlder, marked with a spot of black paint, 20 feet south of the gage rod and 8 feet east of the river bank; elevation, 6.86 feet. (2) Top of white granite bowlder, marked with black paint, on the river bank 250 feet west of the gage; elevation, 8.82 feet. Elevations are above the zero of the gage.

Between the bridge and the gage, about 1½ miles above the latter, Cherry Creek enters the river from the right. In order to determine the total amount of water flowing past the gage, measurements of this creek are always made when the river is measured, and the result is added to that at the bridge above. The gaging station on Cherry Creek is at the wooden highway bridge 100 yards above its mouth.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Descripton: 99, p 130-131; 130, p 77.
Discharge: 99, p 131; 130, p 77.
Discharge, monthly: 99, p 132; 130, p 79.
Gage heights: 99, pp 131-132; 130, p 78.
Rating table: 99, p 132; 130, p 78.

Discharge measurements of Madison River (including Cherry Creek) near Norris, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.	Discharge (Cherry Creek included).
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
April 1	L. R. Stockman	216	376	3.54	1.32	1,330	1,346
May 2	J. H. Sloan	234	340	3.02	1.30	1,335	1,358
May 17	do	232	371	4.22	1.43	1,576	1,612
June 13	do	246	556	6.00	2.21	3,333	3,488
July 5	do	243	505	5.36	1.88	2,714	2,752
August 3	do	232	349	3.55	1.21	1,239	1,250
September 2	do	231	316	3.55	1.23	1,121	1,135
September 26	do	233	320	3.45	1.22	1,104	1,118
October 22	do	232	327	3.46	1.22	1,131	1,146
November 18	do	232	332	3.45	1.22	1,148	1,157

Daily gage height, in feet, of Madison River (including Cherry Creek) near Norris, Mont., for 1905.

	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.4	1.4	1.85	1.9	1.25	1.2	1.2	1.2
2	.....	1.4	1.4	1.95	1.9	1.25	1.2	1.2	1.2
3	.....	1.4	1.4	2.2	2.0	1.25	1.2	1.2	1.2
4	.....	1.4	1.4	2.2	2.0	1.25	1.2	1.2	1.2
5	.....	1.4	1.4	2.3	2.0	1.25	1.2	1.2	1.2
6	.....	1.4	1.4	2.34	2.0	1.25	1.2	1.2	1.2
7	.....	1.4	1.4	2.3	2.0	1.25	1.2	1.2	1.2
8	.....	1.4	1.4	2.3	2.0	1.28	1.2	1.2	1.2
9	.....	1.4	1.45	2.3	2.0	1.3	1.2	1.2	1.2
10	.....	1.4	1.5	2.3	1.6	1.3	1.2	1.2	1.2
11	.....	1.4	1.5	2.3	1.05	1.3	1.22	1.2	1.2
12	1.3	1.4	1.45	2.3	1.15	1.3	1.25	1.2	1.2
13	1.3	1.4	1.45	2.25	1.35	1.3	1.25	1.2	1.2
14	1.4	1.4	1.45	2.2	1.5	1.3	1.25	1.2	1.2
15	1.4	1.4	1.45	2.2	1.5	1.25	1.25	1.2	1.2
16	1.4	1.4	1.5	2.2	1.4	1.2	1.25	1.2	1.2
17	1.4	1.4	1.55	2.2	1.4	1.2	1.25	1.2	1.2
18	1.4	1.4	1.6	2.1	1.4	1.2	1.25	1.2	1.2
19	1.4	1.4	1.65	2.05	1.4	1.2	1.25	1.2	1.2
20	1.4	1.4	1.65	2.0	1.35	1.2	1.25	1.2	1.2
21	1.4	1.4	1.65	1.9	1.35	1.2	1.25	1.2	1.2
22	1.4	1.4	1.3	1.9	1.35	1.2	1.25	1.2	1.2
23	1.4	1.4	1.25	1.9	1.3	1.2	1.25	1.2	1.2
24	1.4	1.4	1.2	1.9	1.3	1.2	1.25	1.2	1.2
25	1.4	1.4	1.2	1.9	1.3	1.2	1.25	1.2	1.2
26	1.4	1.4	1.2	1.8	1.22	1.2	1.25	1.2	.....
27	1.3	1.4	1.1	1.7	1.28	1.2	1.25	1.2	.....
28	1.3	1.4	1.1	1.6	1.3	1.2	1.25	1.2	.....
29	1.3	1.4	1.2	1.6	1.3	1.2	1.25	1.2	.....
30	1.3	1.4	1.5	1.8	1.25	1.2	1.25	1.2	.....
31	1.3	.....	1.6	.....	1.25	1.2	1.25	1.2	.....

NOTE.—River frozen January 1 to March 11 and November 26 to December 31, inclusive.

Station rating table for Madison River (including Cherry Creek), near Norris, Mont., from March 12 to November 25, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	900	1.50	1,770	1.80	2,500	2.10	3,275
1.20	1,100	1.60	2,000	1.90	2,750	2.20	3,550
1.30	1,320	1.70	2,250	2.00	3,000	2.30	3,850
1.40	1,540						

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1904-5 and is fairly well defined throughout.

Estimated monthly discharge of Madison River (including Cherry Creek), near Norris, Mont., for 1905.

[Drainage area, 2,085 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 12-31	1,540	1,320	1,463	58,040	0.702	0.522
April	1,540	1,540	1,540	91,640	.739	.824
May	2,125	900	1,570	96,540	.753	.868
June	3,974	2,000	3,195	190,100	1.53	1.71
July	3,000	800	1,844	113,400	.884	1.02
August	1,320	1,100	1,177	72,370	.565	.651
September	1,210	1,100	1,171	69,680	.562	.627
October	1,100	1,100	1,100	67,640	.528	.609
November 1-25	1,100	1,100	1,100	54,540	.528	.491
The period				814,000		

GALLATIN RIVER AT LOGAN, MONT.

Gallatin River is formed by two chief upper branches, known as East and West Gallatin rivers, which rise on the western slopes of the Gallatin Range and unite a few miles east of Logan, whence the main stream flows northward to its point of junction with Jefferson and Madison rivers near Three Forks, Mont.

A gaging station was established at Logan August 24, 1893. The present station is located 200 yards northwest of the Logan railroad depot.

The channel is straight for 200 feet above and below the station. The right bank is high and rocky. The left is comparatively low and might overflow in the highest floods. Both banks are covered with bushes. The bed of the stream is sandy, with a small amount of vegetation. There is but one channel at all stages, and the current is moderate.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire just below the gage. The initial point for soundings is at the left cable support.

During 1905 gage readings were taken once each day up to October 27 by N. A. Smith. After that date the gage was read by S. M. Kirkbridge. The original gage was a rod fastened to the cribbing at the intake pipe of the pump at the railroad pump house immediately below the old Northern Pacific Railway bridge; but this was washed out, together with the crib, March 10, 1894, before any discharge measurements had been made. November 16, 1894, a new gage rod was installed under the northeast corner of the bridge, and measurements of the river were thereafter made by means of a cable 100 yards above. This gage was replaced September 16, 1896, by a wire gage fastened to the upstream hand rail of the

bridge in the east span. Bench mark No. 2 of this gage answered to the description of bench mark No. 1 of the previous gage. This gage was destroyed in April, 1901, when the old railroad bridge was being replaced. A temporary gage was established for the summer, and July 26, 1901, the datum of this gage was raised 1.23 feet. October 20, 1901, a new wire gage was established on the site of the present station, 150 yards upstream from the bridge, but the readings on this gage had no relation to those of the previous gages. April 16, 1905, the wire was replaced by a standard chain gage, but owing to unreliable descriptions of old bench marks there was probably a slight change in the gage datum at that time. The length of the chain from the end of the weight to the outside of the handle ring is 21.21 feet. The bench marks in present use are as follows: (1) A railroad spike in the west side of the rear post of the gage frame 3.6 feet from the top of the horizontal bar; elevation above the zero of the gage, 8.02 feet. (2) A point halfway down on the beveled edge at the top of the concrete just below the roller bearing on the northeast abutment of the Northern Pacific Railway bridge; elevation above the zero of the gage, 11.71 feet.

This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 128-129; 19, iv, p 277; Bull 131, pp 16-17; 140, p 89; WS 15, p 68; 27, p 68; 36, pp 197-198; 49, p 262; 66, pp 17-18; 84, pp 38-39; 99, pp 123-124; 130, pp 82-83.

Discharge: Ann 18, iv, p 129; Bull 131, pp 17, 92; 140, p 90; WS 15, p 68; 27, p 74; 36, p 198; 49, p 262; 66, p 18; 84, p 39; 99, p 124; 130, p 84.

Discharge, monthly: Ann 18, iv, p 130; 19, iv, p 278; 20, iv, pp 234, 240; 22, iv, p 282; Bull 140, p 91; WS 75, p 116; 84, p 40; 99, p 126; 130, p 85.

Discharge, yearly: Ann 20, iv, p 53.

Gage heights: Bull 131, p 18; 140, p 90; WS 11, p 48; 15, p 68; 27, p 70; 36, p 198; 49, p 263; 66, p 18; 84, p 39; 99, pp 124-125; 130, p 84.

Hydrographs: Ann 18, iv, p 130; 19, iv, p 278; 20, iv, p 240; 22, iv, p 282.

Rainfall and run-off relation: Ann 20, iv, p 235; WS 75, p 118.

Rating tables: Ann 18, iv, p 129; 19, iv, p 277; Bull 140, p 90; WS 27, p 75; 52, p 516; 84, p 40; 99, p 125; 130, p 85.

Discharge measurements of Gallatin River at Logan, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 3	L. R. Stockman	138	380	1.42	1.20	540
May 4	J. H. Sloan	.....	397	1.55	1.35	614
May 19	do	.....	508	2.21	1.94	1,125
June 14	do	150	670	3.64	2.70	2,438
July 8	do	140	340	1.04	.68	353
August 5	do	130	272	.73	.40	200
September 7	do	130	299	.78	.70	235
September 21	do	130	303	.87	.77	263
October 20	do	142	375	1.47	1.28	552
October 27	H. M. Morse	142	392	1.57	1.41	614
November 16	J. H. Sloan	143	391	1.60	1.42	623

Daily gage height, in feet, of Gallatin River at Logan, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.85	1.2	1.45	.....	1.3	2.1	2.5	0.4	0.6	1.1	1.3	2.1
2	2.55	1.15	1.45	.....	1.3	2.4	2.6	.3	.6	1.1	1.4	2.1
3	2.4	1.5	1.4	.....	1.3	2.65	2.45	.4	.6	1.1	1.5	1.8
4	1.85	3.9	1.4	.....	1.3	2.7	[a] 2.35	.4	.6	1.1	1.5	1.6
5	1.6	3.9	1.4	1.2	1.3	3.1	2.25	.4	.6	1.1	1.4	1.9
6	1.5	3.9	1.4	1.15	1.3	3.0	1.8	[a] 4	.7	1.1	1.4	2.1
7	1.6	3.9	1.4	1.1	1.25	2.9	1.3	.4	.7	1.1	1.4	1.7
8	1.8	3.9	1.4	1.1	1.25	2.85	.8	.4	.7	1.1	1.4	1.5
9	1.8	3.9	1.35	1.2	1.4	3.25	.6	.45	.7	1.1	1.4	1.5
10	1.6	3.9	1.35	1.3	1.7	3.25	.5	.5	.7	1.15	1.4	1.9
11	1.5	3.9	1.35	1.3	1.65	3.0	[a] .45	.5	.7	[a] 1.18	1.4	1.9
12	1.5	3.8	1.35	1.3	1.6	2.9	.4	.6	.65	1.2	1.4	2.0
13	1.5	3.8	1.35	1.2	1.5	2.8	.4	.6	[a] .65	1.2	1.4	2.0
14	1.5	3.85	1.35	1.2	1.35	2.7	.4	.6	.65	1.2	1.4	2.0
15	1.8	3.85	1.35	1.25	1.35	2.6	.45	.6	.65	1.2	1.4	2.2
16	2.0	3.85	1.35	1.25	1.4	2.5	.45	.6	.7	1.2	1.4	2.4
17	2.2	3.85	1.4	1.3	1.35	2.5	.4	.7	.65	1.2	1.4	1.9
18	1.8	3.85	1.4	1.25	1.7	2.6	.4	.7	.7	1.2	1.4	1.9
19	1.8	3.85	1.35	1.25	1.8	2.8	.4	.7	.75	1.25	1.4	1.8
20	1.7	3.9	1.35	1.25	1.85	2.9	.4	.7	.8	1.25	1.4	1.8
21	1.5	3.9	1.35	1.25	1.9	2.0	.35	.7	.8	1.25	1.5	1.8
22	1.5	3.85	1.35	1.2	2.0	2.1	.3	.6	.8	1.3	1.4	1.8
23	1.5	3.8	1.3	1.25	1.9	2.2	.3	.6	.8	1.3	1.4	1.8
24	1.45	3.7	1.3	1.25	1.8	2.3	.4	.7	.8	1.4	1.4	2.5
25	1.45	3.0	1.3	1.3	1.7	2.4	.4	.7	.8	1.4	1.4	2.7
26	1.4	2.0	.....	1.3	1.7	2.55	.4	.7	.85	1.4	1.5	3.0
27	1.4	1.55	.....	1.3	1.75	2.4	.4	.6	.9	1.4	1.5	3.8
28	1.4	1.5	.....	1.3	2.65	2.3	.4	.6	.95	1.4	1.5	4.5
29	1.4	.....	.....	1.3	2.65	2.1	.4	.6	1.0	1.3	1.2	4.2
30	1.3	.....	.....	1.3	2.9	2.25	.4	.6	1.1	1.3	2.1	3.8
31	1.25	.....	.....	.....	2.7	.....	.4	.6	.....	1.2	.....	3.8

[a] Gage heights interpolated.

NOTE.—January 1-10, ice gorge below station; also February 4-26, inclusive. January 30 to February 3, inclusive, December 28-31, inclusive; readings to top of ice; drift ice floating in the river. November 29 to December 27, inclusive, ice floating in the river and probably gorge below for part of the time. River open January 11-29 and February 27 to November 28, inclusive. Gage destroyed March 26; replaced April 4.

Station rating table for Gallatin River at Logan, Mont., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	178	1.30	545	2.20	1,210	3.20	2,205
.40	192	1.40	605	2.30	1,300	3.40	2,445
.50	210	1.50	670	2.40	1,390	3.60	2,685
.60	230	1.60	740	2.50	1,480	3.80	2,950
.70	260	1.70	810	2.60	1,570	4.00	3,240
.80	300	1.80	880	2.70	1,670	4.20	3,540
.90	340	1.90	955	2.80	1,770	4.40	3,870
1.00	385	2.00	1,035	2.90	1,870	4.60	4,230
1.10	435	2.10	1,120	3.00	1,980	4.80	4,620
1.20	485						

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5, and is not well defined.

Estimated monthly discharge of Gallatin River at Logan, Mont., for 1905.

[Drainage area, 1,805 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 11-29	1,210	605	741	27,930	0.411	0.290
March 1-25	635	545	586	29,060	.324	.302
April 5-30	545	435	512	26,400	.284	.275
May	1,870	515	836	51,400	.463	.534
June	2,265	1,035	1,592	94,730	.882	.984
July	1,570	178	428	26,320	.237	.273
August	260	178	225	13,840	.125	.144
September	435	230	279	16,600	.155	.173
October	605	435	499	30,680	.276	.318
November 1-28	670	545	617	34,270	.342	.356
The period				351,200		

NOTE.—No estimate for ice period.

WEST GALLATIN RIVER NEAR SALESVILLE, MONT.

West Gallatin River joins the East Gallatin a few miles east of Logan, Mont.

The gaging station was established in July, 1895. It is located at the Williams highway bridge, 16 miles southwest of Bozeman, Mont., from which point it is reached by driving. The nearest post-office is Salesville, 4 miles below the station.

The channel is nearly straight, with slight curves above and below the station. The banks are high and not liable to overflow. The bed of the stream is composed of bowlders and is fairly permanent. At flood stages water flows behind the bridge abutment near the right bank; at other times it is all confined in one channel. The bridge is not quite at a right angle to the direction of the current. During high water discharge measurements are frequently rendered impossible by the logs and ties which are floated down the river from the canyon to the Northern Pacific Railway. On account of the velocity of the current a stay wire is needed for the meter at nearly all stages of the river.

Discharge measurements are made from the lower side of the highway bridge. The initial point for soundings is on the guard rail over the left pier.

The gage was read until June 30, 1905, by Mrs. Alvin DeLong, who lived near the bridge; on that date gage readings were discontinued on account of difficulty in procuring an observer. The gage record was begun August 1, 1895. The gage first installed was a rod firmly spiked to a tree above the bridge, near the right bank. May 31, 1896, the datum was lowered 5 feet, and the rod was regraduated so as to correspond to the new datum. This gage is still in place, and is frequently used at high stages, as it stands in less turbulent water. In September, 1896, a wire gage was placed on the upstream side of the bridge and made to read the same as the rod gage. This was replaced April 20, 1904, by a standard chain gage, approximately the same datum being maintained. The present chain length is 17.43 feet. August 22, 1904, the rod gage was found to read 0.16 foot low as compared with the chain-gage datum. The new gage is referred to bench marks as follows: (1) The head of the westernmost rivet holding the angle irons on the top of the southwest cylindrical pier; elevation, 13.86 feet. (2) A large bowlder firmly set in the ground on the south side of the wagon road near the fence and 123 feet east of the southeast pier; elevation, 13.69 feet. Elevations are above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, p 101; 18, iv, p 124; 19, iv, p 275; Bull 140, pp 86-87; WS 15, p 66; 27, p 68; 36, pp 195-196; 49, pp 260-261; 66, pp 16-17; 84, pp 40-41; 99, pp 126-127; 130, pp 79-80.

Discharge: Ann 18, iv, p 125; Bull 131, p 90; 140, p 86; WS 15, p 66; 27, pp 68, 74; 36, p 196; 49, p 261; 66, p 17; 84, p 41; 99, p 127; 130, p 80.

Discharge, monthly: Ann 14, ii, p 102; 18, iv, p 126; 19, iv, p 276; 20, iv, pp 234, 241; 21, iv, p 184; 22, iv, p 280; Bull 140, p 88; WS 75, pp 117, 118; 84, p 43; 99, p 129; 130, p 82.

Discharge, yearly: Ann 20, iv, p 52.

Gage heights: Bull 140, p 87; WS 11, p 47; 15, p 66; 27, p 69; 36, p 196; 49, p 261; 66, p 17; 84, p 42; 99, pp 127-128; 130, p 81.

Hydrographs: Ann 18, iv, p 126; 19, iv, p 277; 20, iv, p 241; 21, iv, p 185; 22, iv, p 281; WS 75, p 119.

Rainfall and run-off relation: Ann 20, iv, p 235; WS 75, p 118.

Rating tables: Ann 18, iv, p 125; 19, iv, p 276; Bull 140, p 87; WS 27, p 75; 39, p 446; 52, p 516; 66, p 170; 84, p 42; 99, p 128; 130, p 81.

Discharge measurements of West Gallatin River near Salesville, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 31	L. R. Stockman	83	183	1.88	2.90	343
May 1	J. H. Sloan	87	217	2.48	3.30	538
May 17	do	90	234	3.06	3.59	718
June 12	do	130	416	6.45	5.30	2,681
August 2	do	87	201	2.30	3.10	463
September 1	do	85	181	2.15	2.95	390
September 25	do	83	178	1.92	2.96	343
October 21	do	86	196	2.23	3.05	438
November 17	do	85	190	2.24	3.04	426

Daily gage height, in feet, of West Gallatin River near Salesville, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Aug.	Sept.	Oct.	Nov.
1	2.8	2.9	2.9	2.8	3.4	4.6	.....	2.95	.....	.....
2	2.9	2.9	2.9	2.9	3.2	4.9	3.10	.....	.....	.....
3	2.9	2.9	2.9	2.9	3.2	5.1	.....	.....	.....	.....
4	2.9	2.9	2.9	2.9	3.1	5.2	.....	.....	.....	.....
5	3.0	2.9	2.9	2.9	3.1	5.2	.....	.....	.....	.....
6	3.0	3.0	2.9	2.9	3.1	5.1	.....	.....	.....	.....
7	3.0	3.0	2.9	2.9	3.1	5.1	.....	.....	.....	.....
8	2.9	3.0	2.9	2.9	3.4	5.3	.....	.....	.....	.....
9	2.9	3.0	2.9	2.9	3.5	4.9	.....	.....	.....	.....
10	3.0	3.0	3.0	2.9	3.3	4.8	.....	.....	.....	.....
11	2.8	3.0	3.0	2.9	3.2	5.2	.....	.....	.....	.....
12	2.8	3.0	3.0	2.9	3.2	5.3	.....	.....	.....	.....
13	2.9	3.0	3.0	3.0	3.2	5.3	.....	.....	.....	.....
14	2.9	3.1	3.0	3.0	3.3	5.3	.....	.....	.....	.....
15	2.9	3.1	2.9	3.0	3.3	5.3	.....	.....	.....	.....
16	2.9	3.2	2.9	3.0	3.3	5.2	.....	.....	.....	.....
17	2.9	3.4	2.9	3.0	3.4	5.2	.....	.....	.....	3.04
18	2.9	3.5	2.9	3.1	3.6	5.0	.....	.....	.....	.....
19	2.9	3.3	2.9	3.1	3.9	4.8	.....	.....	.....	.....
20	2.9	3.3	2.9	3.1	3.7	4.4	.....	.....	.....	.....
21	2.9	3.1	2.8	3.1	3.7	4.5	.....	.....	3.05	.....
22	2.9	3.0	2.8	3.1	3.8	4.8	.....	.....	.....	.....
23	2.9	3.0	2.9	3.1	3.8	4.8	.....	.....	.....	.....
24	2.9	2.9	2.9	3.1	3.8	4.9	.....	.....	.....	.....
25	2.9	2.9	2.9	3.2	3.8	4.7	.....	.....	.....	.....
26	2.9	2.9	2.9	3.4	3.8	4.7	.....	2.96	.....	.....
27	2.9	2.9	2.9	3.4	3.7	4.8	.....	.....	.....	.....
28	2.9	2.9	2.9	3.3	3.7	4.6	.....	.....	.....	.....
29	2.9	.....	2.9	3.2	3.7	4.4	.....	.....	.....	.....
30	2.9	.....	2.8	3.2	3.9	4.4	.....	.....	.....	.....
31	2.9	.....	2.8	.....	4.2	.....	.....	.....	.....	.....

NOTE.—No observer July 1 to December 31, inclusive. Open-channel conditions assumed during winter months. Gage heights interpolated March 1–4, inclusive, and April 8.

Station rating table for West Gallatin River near Salesville, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.80	310	3.50	670	4.20	1,265	4.90	2,105
2.90	350	3.60	740	4.30	1,370	5.00	2,245
3.00	395	3.70	815	4.40	1,480	5.10	2,390
3.10	440	3.80	895	4.50	1,595	5.20	2,545
3.20	490	3.90	980	4.60	1,715	5.30	2,700
3.30	545	4.00	1,070	4.70	1,840	5.40	2,865
3.40	605	4.10	1,165	4.80	1,970	5.50	3,040

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1904–5, and is fairly well defined between gage heights 3 feet and 5 feet.

Estimated monthly discharge of West Gallatin River near Salesville, Mont., for 1905.

[Drainage area, 860 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	395	310	352	21,640	0.409	0.472
February	670	350	415	23,050	.483	.503
March	395	310	352	21,640	.409	.472
April	605	310	415	24,690	.483	.539
May	1,265	440	690	42,430	.802	.925
June	2,700	1,480	2,155	128,200	2.51	2.80
The period				261,600		

MISSOURI RIVER AT CASCADE, MONT.

This station was established July 20, 1902. It is located at the highway bridge at the east end of the town of Cascade, Mont., about one-fourth mile from the railroad.

The channel is straight 600 feet above the station to the island in the center of the stream; another island, 200 feet below the bridge, divides the river into two channels and causes a rather sudden change in the direction of the current. A fall of about 1 foot at this island produces rapids in the river below the station. The left bank is high, but the right may overflow at extreme flood stages. The central pier of the bridge is protected by an ice breaker, which extends about 125 feet upstream and has considerable effect on the current to the left, especially in low water.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is near the left bank; it is a notch on the guard rail 2 feet to the left of the center of the southwest pier.

A standard chain gage, which is read twice each day by H. W. Ludwig, has replaced the chain gage first installed. It is located on the upstream side of the left span and is fastened to the floor of the bridge. The length of the chain is 31.99 feet. The gage is referred to bench marks as follows: (1) The top of an old iron bolt which secures the bed plate on the southwest iron bridge pier; it is painted in black "U.S.G.S.B.M." and has an elevation of 28.54 feet above gage datum. (2) A standard iron bench mark of the Missouri River Commission, situated 200 feet south of the Great Northern Railway station; elevation above the zero of the gage, 36.58 feet.

Information in regard to this station is contained in the following Water-Supply Paper of the United States Geological Survey:

Description: 84, p 35; 99, p 117; 130, p 72.
Discharge: 84, p 35; 99, p 117; 130, p 73.
Discharge, monthly: 99, p 119; 130, p 74.
Gage heights: 84, p 36; 99, p 118; 130, p 73.
Rating table: 99, p 118; 130, p 74.

Discharge measurements of Missouri River at Cascade, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 5	L. R. Stockman	349	2,537	1.37	4.20	3,484
May 12	H. M. Morse	.....	2,643	1.77	4.59	4,696
June 13	do	371	3,355	2.88	6.44	9,669
July 12	W. B. Freeman	356	2,618	1.53	4.60	4,013
August 8	H. M. Morse	348	2,443	.72	3.74	1,769
September 12	W. B. Freeman	350	2,253	.91	3.58	2,043
November 21	do	354	2,525	1.35	4.31	3,412

Daily gage height, in feet, of Missouri River at Cascade, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.6	4.1	4.55	4.4	4.6	4.6	6.55	4.1	3.6	3.3	3.95	5.5
2	4.6	4.1	4.45	4.4	4.6	4.6	6.35	4.05	3.6	3.3	4.0	5.5
3	4.6	4.1	4.35	4.4	4.6	4.65	6.15	3.98	3.6	3.3	4.0	5.5
4	4.6	4.2	4.3	4.38	4.5	4.72	5.9	3.88	3.6	3.3	4.0	5.5
5	4.6	4.2	4.3	4.35	4.5	4.8	5.8	3.85	3.6	3.3	4.0	5.5
6	4.6	4.2	4.4	4.3	4.5	5.15	5.75	3.75	3.6	3.4	4.05	5.5
7	4.6	4.2	4.4	4.3	4.5	5.95	5.45	3.75	3.6	3.4	4.08	5.5
8	4.6	4 2	4 4	4.25	4 5	6.22	5.32	3.75	3 6	3.4	4.1	5.5
9	4.6	4.3	4.5	4.2	4.5	6.45	5.25	3.75	3.6	3.4	4.15	5.5
10	4.7	4.3	4.5	4.2	4.5	6.6	5.2	3.75	3.6	3.4	4.18	5.4
11	4.7	4.3	4.5	4.2	4.5	6.6	4.75	3.75	3.6	3.45	4.2	5.3
12	4.8	4.28	4.5	4.25	4.6	6.58	4.58	3.75	3.6	3.5	4.2	5.2
13	4.8	4.32	4.5	4.28	4.65	6.45	4.5	3.75	3.6	3.6	4.2	4.95
14	4.8	5.25	4.5	4.3	4.65	6.4	4.48	3.75	3.6	3.6	4.2	4.75
15	4.8	5.75	4.5	4.35	4.65	6.65	4.38	3.75	3.6	3.63	4.23	4.65
16	4.8	5.9	4.5	4.4	4.65	6.6	4.3	3.78	3.6	3.7	4.25	4.55
17	4.7	5.92	4.5	4.4	4.7	6.55	4.25	3.65	3.6	3.75	4.25	4.5
18	4.7	5.95	4.5	4.45	4.7	6.35	4.2	3.5	3.55	3.8	4.28	4.6
19	4.6	5.95	4.5	4.45	4.68	6.2	4.12	3.5	3.52	3.85	4.3	4.6
20	4.6	5.95	4.5	4.48	4.65	6.15	4.05	3.5	3.5	3.87	4.3	4.7
21	4.5	5.72	4.5	4.5	4.62	5.98	4.0	3.5	3.45	3.9	4.3	4.7
22	4.5	5.55	4.5	4.5	4.6	5.88	4.0	3.45	3.42	3.9	4.35	4.7
23	4.4	5.3	4.5	4.5	4.58	5.75	3.95	3.45	3.4	3.9	4.35	4.7
24	4.4	5.05	4.5	4.55	4.52	5.5	3.95	3.45	3.4	3.9	4.4	4.7
25	4.3	4.9	4.5	4.6	4.48	5.25	3.95	3.48	3.4	3.9	4.43	4.7
26	4.3	4.85	4.5	4.6	4.42	5.12	4.05	3.52	3.4	3.9	4.48	4.7
27	4.2	4.75	4.5	4.65	4.35	6.28	4.0	3.55	3.3	3.9	4.55	4.7
28	4.2	4.65	4.5	4.7	4.38	6.42	4.0	3.4	3.3	3.95	4.75	4.7
29	4.1	.....	4.45	4.7	4.45	6.55	3.95	3.5	3.3	3.95	5.5	4.7
30	4.1	.....	4.45	4.7	4.5	6.65	4.0	3.5	3.3	3.95	5.5	4.7
31	4.1	.....	4.4	.....	4.55	.....	4.0	3.6	.....	3.95	.....	4.7

NOTE.—River frozen and readings taken to the surface of the ice January 1 to February 28, inclusive, and November 28 to December 19, inclusive.

Station rating table for Missouri River at Cascade, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	1,720	4.20	3,120	5.10	5,500	6.00	8,260
3.40	1,800	4.30	3,340	5.20	5,800	6.10	8,580
3.50	1,900	4.40	3,560	5.30	6,100	6.20	8,900
3.60	2,020	4.50	3,800	5.40	6,400	6.30	9,220
3.70	2,160	4.60	4,060	5.50	6,700	6.40	9,560
3.80	2,320	4.70	4,320	5.60	7,000	6.50	9,900
3.90	2,500	4.80	4,600	5.70	7,300	6.60	10,240
4.00	2,700	4.90	4,900	5.80	7,620		
4.10	2,900	5.00	5,200	5.90	7,940		

The above table is applicable only for open channel conditions. It is based on 15 discharge measurements made during 1904-5, and is well defined between gage heights 3.5 feet and 6.5 feet.

Estimated monthly discharge of Missouri River at Cascade, Mont., for 1905.

[Drainage area, 18,295 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	3,930	3,340	3,721	228,800	0.203	0.234
April	4,320	3,120	3,635	216,300	.199	.222
May	4,320	3,450	3,944	242,500	.216	.249
June	10,410	4,060	8,081	480,900	.442	.493
July	10,070	2,600	4,518	277,800	.247	.285
August	2,900	1,800	2,147	132,000	.117	.135
September	2,020	1,720	1,929	114,800	.105	.117
October	2,600	1,720	2,150	132,800	.118	.136
November 1-27	3,930	2,600	3,158	169,100	.173	.174
The period				1,995,000		

MISSOURI RIVER AT GREAT FALLS, MONT.

The flow of Missouri River at Great Falls, Mont., is divided into four parts:

1. Water flowing over Black Eagle Falls dam.
2. Water leaking through the dam.
3. Water used on the north side of the river by the Boston and Montana smelter.
4. Water used on the south side of the river by the electric light and power company and the Royal Milling Company.

Black Eagle Falls dam was begun April 15, 1890, and completed March 15, 1891.[a] The total cost of the dam from the inception of the enterprise to November 30, 1891, was $175,000. Originally the crest of the dam stood 40 feet above the surface of the water below the falls in the tailrace; but September 1, 1904, additional flashboards were erected, and the crest has since been 41 feet above the water in the tailrace. The original elevation of the flashboards on the crest was 3,282.05 feet above sea level. The present elevation is 3,282.18 feet. The wooden crest was sharp, but is now slightly worn by water and ice. The length of the dam is 745 feet. The amount of water flowing over it can be computed by using the dam as a weir.

[a] Parker, M. S., Black Eagle Falls dam: Trans. Am. Soc. Civ. Eng., vol. 27, 1892, p. 56.

The Boston and Montana smelter has a gage above the dam which is read four times daily. The difference between gage readings and the elevation of the crest gives the head on the crest. Records of gage heights have been kept since April 13, 1897. The zero of the gage stands at an elevation of 3,200 feet above sea level.

October 5, 1905, the water leaking through the dam was measured and found to be 72 second-feet. The water was low at the time (gage height, 3,280.80 feet), and it is probable that a greater head would increase the amount of leakage.

The water power is owned by the Great Falls Water Power and Townsite Company and is sold to various corporations. A record is kept of the horsepower developed, the computations being based on gate openings and heads, using an efficiency of 80 per cent for the turbines. From the monthly average of horsepower and head computation has been made of the monthly average of water used by the Boston and Montana smelter from 1897 to 1905, and the results are shown in the accompanying table.

On the south side of the river the Royal Milling Company pays for 300 horsepower delivered at the top of the bank. No regular record is kept of the amount of water used, but occasional tests are made to determine whether the required horsepower is developed. The electric-light and power company contracts for 1,000 horsepower, and as it is used for lighting and traction purposes the required amount is constantly changing and hourly records are kept. The average total horsepower used on the south side of the river is 1,300. Based on an efficiency of 80 per cent and a head of 41 feet, the flow required to develop this power is 349 second-feet.

An approximate idea of the quantity of water in the Missouri at Great Falls could be obtained by combining the various parts noted above.

Water from Missouri River used by Boston and Montana smelter at Great Falls, Mont., 1897–1905.

Month.	Second-feet.	Acre-feet.	Month.	Second-feet.	Acre-feet.
1897.			1899.		
April	1,400	83,310	January	1,764	108,500
July	1,343	82,580	February	1,795	99,690
August	1,359	83,560	March	1,804	110,900
September	1,484	88,300	April	1,763	104,900
October	1,469	90,310	May	1,783	109,600
November	1,462	87,000	June	1,792	106,600
December	1,441	88,600	July	1,803	110,900
			August	1,838	113,000
The period		603,700	September	1,791	106,600
			October	1,684	103,500
1898.			November	1,839	109,400
January	1,531	94,140	December	1,831	112,600
February	1,332	73,980			
March	953	58,600	The year	1,791	1,296,000
April	984	58,550			
May	1,277	78,520	1900.		
June	1,530	91,040	January	1,760	108,200
July	1,449	89,100	February	1,839	102,100
August	1,729	106,300	March	1,881	115,700
September	1,663	98,960	April	1,884	112,100
October	1,711	105,200	May	1,722	105,900
November	1,711	101,800	June	1,832	109,000
December	1,753	107,800	July	1,844	113,400
			August	1,898	116,700
The year	1,469	1,064,000	September	1,786	106,300
			October	1,752	107,700

Water from Missouri River used by Boston and Montana smelter at Great Falls, Mont., 1897–1905—Continued.

Month.	Second-feet.	Acre-feet.
1900—Continued.		
November	1,708	101,600
December	1,849	113,700
The year	1,813	1,312,000
1901.		
January	1,375	84,550
February	1,579	87,690
March	1,688	103,800
April	2,028	120,700
May	2,077	127,700
June	2,121	126,200
July	1,983	121,900
August	1,874	115,200
September	1,806	107,500
October 1–24	1,773	84,400
The period	.....	1,080,000
1902.		
January 13–31	1,355	51,070
February	1,780	98,860
March	2,202	135,400
April	2,222	132,200
May	2,226	136,900
June	2,375	141,300
July	2,243	137,900
August	1,980	121,800
September	1,782	106,000
October	2,161	132,900
November	2,020	120,200
December	1,794	110,300
The period	.....	1,425,000
1903.		
January	2,200	135,300
February	1,962	109,000
March	2,087	128,300
April	2,239	133,200
1903—Continued.		
May	2,128	130,800
June	2,196	130,700
July	2,252	138,500
August	2,216	136,300
September	1,707	101,600
October	1,912	117,600
November	1,183	70,390
December	2,036	125,200
The year	2,010	1,457,000
1904.		
January	2,016	124,000
February	1,953	112,300
March	2,216	136,300
April	2,321	138,100
May	2,341	143,900
June	2,114	125,800
July	2,225	136,800
August	2,153	132,400
September	1,737	103,400
October	2,143	131,800
November	2,199	130,800
December	2,027	124,600
The year	2,120	1,540,000
1905.		
January	1,955	120,200
February	1,882	104,500
March	2,304	141,700
April	2,297	136,700
May	2,243	137,900
June	2,300	136,800
July	2,231	137,200
August	1,669	102,600
September	1,214	72,240
October	1,402	86,200
The period	.....	1,176,000

MISSOURI RIVER NEAR WILLISTON, N. DAK.

This station was established April 24, 1905. It is located at Bakers Ferry, 10 miles down the river from Williston, N. Dak., and 13½ miles southeast by the main traveled road on the east side of the river from Williston ferry landing.

The channel is straight for about 1,750 feet both above and below the station. The right bank consists of stiff clay and rises to an elevation of 25 feet above gage zero; the left bank is composed of loose sand and slopes upward to an elevation of 22 feet above gage zero; neither bank is subject to overflow. The bed of the stream is of sand and is shifting.

Discharge measurements are made from a cable ferry boat. The initial point for soundings is the face of the cut bank on the right shore.

A standard chain gage, which was read during 1905 by George E. Baker, is located on a projecting timber extending 20 feet from the bank of the river. The length of the chain

from the end of the weight to the marker is 37.80 feet. The gage is referred to bench marks as follows: (1) An aluminum tablet set in the top of a 6 by 6 inch square post about 20 feet west of the gage; elevation, 26.92 feet. (2) A cross of staples in the flat top of a large post, 4 feet high, about 3 rods southeast of the gage and 2 feet northwest of the supporting pole at the right end of the ferry cable; elevation, 30.00 feet. Elevations are above the datum of the gage.

Discharge measurements of Missouri River near Williston, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 22	Chandler and Richards	507	4,543	2.78	6.58	12,640
April 24	E. F. Chandler	525	4,480	2.32	5.26	10,390
June 21	P. M. Churchill	787	13,280	5.24	12.20	69,510
July 10	do	770	11,710	4.95	11.10	58,030
August 14	do	753	5,925	2.51	6.70	14,880
September 19	Chandler and Fellows	435	2,705	2.51	4.41	6,781

Daily gage height, in feet, of Missouri River near Williston, N. Dak., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	9.3	12.1	9.8	4.9	4.9	5.0
2	.....	9.4	12.6	9.0	4.8	4.8	5.0
3	.....	10.4	12.3	9.5	4.9	5.1	5.2
4	.....	11.0	12.0	9.8	4.9	5.6	5.2
5	.....	11.3	12.6	9.1	4.9	5.3	5.1
6	.....	11.8	11.9	9.1	4.9	5.0	4.9
7	.....	13.0	11.6	8.8	4.9	5.5	4.9
8	.....	13.6	11.5	8.2	4.8	5.2	4.9
9	.....	13.2	11.2	7.9	4.8	4.9	4.9
10	.....	13.2	11.1	7.8	4.8	4.5	5.0
11	.....	12.9	11.2	7.5	4.7	4.5	5.0
12	.....	13.5	11.2	7.3	4.7	4.4	5.1
13	.....	13.4	11.1	7.1	4.7	4.3	5.0
14	.....	12.8	11.1	6.8	4.6	4.3	5.0
15	.....	12.4	11.0	6.7	4.6	4.2	5.0
16	.....	12.4	11.1	6.5	4.6	4.2	5.1
17	.....	12.9	11.0	6.4	4.6	4.4	5.0
18	.....	12.8	11.0	6.5	4.5	4.4	5.0
19	.....	12.5	11.2	6.3	4.4	4.5	4.9
20	.....	12.3	11.0	6.1	4.4	4.7	4.9
21	.....	12.2	10.6	6.0	4.4	4.8	4.9
22	.....	12.3	10.2	5.9	4.4	4.9	5.0
23	6.7	11.8	9.9	5.8	4.3	4.9	5.0
24	7.6	11.5	9.8	5.7	4.3	4.9	5.0
25	8.0	11.5	9.4	5.5	4.2	5.0	4.9
26	7.9	11.8	9.0	5.4	4.1	5.0	5.0
27	8.4	12.2	8.9	5.3	4.0	5.0	5.1
28	9.3	12.1	8.9	5.2	4.0	4.9	[a] 2.1
29	9.5	11.8	9.2	5.1	4.0	4.9	4.6
30	9.3	11.9	9.5	5.0	4.0	4.9	4.9
31	9.2	.....	10.9	4.9	.....	4.9	.....

[a] Ice gorge above held water back.

NOTE.—River frozen over November 30.

MISSOURI RIVER AT WASHBURN, N. DAK.

This station was established June 28, 1905, and was discontinued November 30, 1905. A record of river stages only was desired, and no discharge measurements were made. A staff gage is attached to the piling foundation of the "Soo" Railroad grain elevator on the left bank of the river. During 1905 the gage was read by Charles W. Blunt. Bench marks were established as follows: (1) A horizontal line of brass-head nails and spikes driven into the pile to which the gage is fastened; elevation, 14.00 feet. (2) A similar line of nails driven into the pile at the east end of the retaining wall below the elevator; elevation, 14.00 feet. Elevations refer to the datum of the gage.

Daily gage height, in feet, of Missouri River near Washburn, N. Dak., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	8.65	6.35	3.9	3.0	3.3	17	.....	7.8	5.1	3.55	2.9	3.0
2	.....	8.9	7.0	3.9	3.0	3.05	18	.....	7.75	5.05	3.5	2.9	3.0
3	.....	9.25	7.35	3.8	3.0	3.1	19	.....	7.75	4.9	3.45	2.85	3.0
4	.....	9.45	6.85	3.8	3.0	3.0	20	.....	7.45	4.9	3.4	2.8	3.0
5	.....	9.05	6.65	3.8	3.0	3.0	21	.....	7.4	4.9	3.35	2.8	3.0
6	.....	9.2	6.65	3.8	3.0	3.1	22	.....	7.45	4.9	3.25	2.8	3.0
7	.....	9.3	6.7	3.75	3.0	3.15	23	.....	7.3	4.7	3.2	2.9	2.9
8	.....	9.1	6.55	3.6	3.0	3.2	24	.....	7.25	4.5	3.15	2.9	2.9
9	.....	8.95	6.45	3.6	3.25	3.2	25	.....	7.05	4.45	3.1	2.95	3.0
10	.....	8.75	6.1	3.6	3.35	3.1	26	.....	6.9	4.4	3.05	3.0	3.0
11	.....	8.65	5.85	3.6	3.5	3.1	27	.....	6.85	4.3	3.0	3.0	3.0
12	.....	8.55	5.7	3.6	3.45	3.1	28	9.65	6.65	4.3	3.0	3.05	3.0
13	.....	8.4	5.55	3.6	3.2	3.0	29	8.95	6.5	4.25	3.0	3.1	.....
14	.....	8.25	5.35	3.6	3.15	3.0	30	8.55	6.45	4.15	3.0	3.05	.....
15	.....	8.05	5.4	3.6	3.0	3.0	31	.....	6.3	4.0	.....	3.2	.....
16	.....	7.85	5.3	3.6	2.95	3.0							

MISSOURI RIVER NEAR BISMARCK, N. DAK.

This station was established September 28, 1904. It is located near the town of Bismarck, N. Dak.

The channel is straight for one-half mile both above and below the station. The right bank is high and not subject to overflow; the left bank consists of sandy slopes and wooded bottoms and is overflowed at extreme flood stages. The bed is sandy and shifts considerably. At ordinary stages the velocity of the current is moderate.

Discharge measurements are made by means of a cable ferryboat at Fort Lincoln ferry, about 5 miles southwest of Bismarck. The initial point for soundings is the face of the perpendicular bank on the right side of the river. Distances from the initial point are obtained by stadia sights from the boat on rods placed on each shore.

A braided-wire gage, which was read during 1905 by Mrs. J. S. Plants, is located on the Northern Pacific Railway bridge, about 2 miles west of Bismarck, near the middle of the second span of the bridge from the left bank. The bench mark is the top of the railroad track on the Northern Pacific Railway bridge at the gage; elevation above the datum of the gage, 73.90 feet. The zero of the gage is 1,617.9 feet above sea level.

Information in regard to this station is contained in Water-Supply Paper No. 130, of the United States Geological Survey, page 76.

Discharge measurements of Missouri River near Bismarck, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 23	Chandler and Richards	848	9,400	5.23	6.80	49,200
July 10	do	808	9,035	5.45	6.70	49,220
August 9	R. Richards	820	7,592	3.81	4.20	28,940
August 30	do	780	4,144	3.20	1.30	13,250
October 18	E. F. Chandler	715	2,903	2.77	—.60	8,042

Daily gage height, in feet, of Missouri River near Bismarck, N. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	3.8	1.6	2.5	0.8	0.2	3.35	6.8	3.65	0.9	—0.9	-0.3	—0.9
2	3.6	2.0	2.5	.8	.2	3.9	6.95	4.0	.7	— .9	— .6	— .6
3	3.4	2.2	2.7	.8	.4	3.9	7.4	4.65	.6	— .9	— .25	— .6
4	3.4	2.2	2.8	.8	.4	3.7	7.8	4.8	.5	— .9	— .4	— .3
5	3.2	2.5	2.95	.8	.1	3.8	7.75	4.45	.5	— .9	— .5	— .7
6	3.05	2.6	3.2	.8	.2	4.35	7.4	4.1	.4	— .9	— .5	— .7
7	2.75	2.6	3.45	.7	.2	4.8	7.4	4.15	.3	— .8	— .2	— .5
8	2.5	2.6	3.65	.6	.25	5.9	7.15	4.25	.3	— .2	— .1	— .5
9	2.4	2.6	4.1	.6	.5	7.7	6.95	4.2	.2	.1	+ .1	— .5
10	2.1	2.6	4.5	.5	.6	7.9	6.7	4.05	.2	.4	.1	— .6
11	1.85	2.5	4.6	.5	.7	7.2	6.55	3.7	.2	.3	.0	— .4
12	1.5	2.4	4.5	.3	.8	6.95	6.35	3.4	.2	.4	.0	— .4
13	1.4	2.4	4.2	.1	.9	7.4	6.15	3.2	.0	.2	.0	— .4
14	1.4	2.2	4.0	.1	1.25	7.8	6.0	3.1	.1	.2	— .2	— .5
15	1.75	2.1	4.0	.1	1.35	7.5	5.9	2.85	.3	— .2	— .2	— .5
16	2.0	1.8	4.15	.0	1.6	7.0	5.6	2.7	.4	— .4	— .3	— .5
17	2.1	1.8	4.45	.0	1.7	6.8	5.4	2.6	.3	— .5	— .3	— .7
18	2.45	1.7	4.6	.0	1.8	7.0	5.3	2.5	.3	— .6	— .3	— .8
19	2.5	1.6	4.95	.0	1.95	7.45	5.3	2.3	.3	— .7	— .3	— .8
20	2.6	1.5	5.15	.0	2.2	7.35	5.1	2.2	.1	— .8	— .3	— .7
21	2.6	1.6	5.05	.0	2.4	7.05	4.9	2.2	.1	— .8	— .3	— .1
22	2.6	1.8	5.7	.0	2.35	6.8	4.9	2.2	.0	— .8	— .3	.0
23	2.4	2.0	8.6	.2	2.1	6.8	4.85	2.2	— .1	— .8	— .3	.3
24	2.4	2.1	5.1	.2	1.7	7.0	4.7	1.95	— .2	— .8	— .3	.5
25	2.3	2.1	3.05	.1	1.55	6.7	4.6	1.8	— .2	— .6	— .3	.6
26	2.05	2.1	2.0	.1	1.4	6.5	4.35	1.8	— .4	— .6	— .3	.7
27	1.75	2.5	1.45	.1	1.5	5.9	4.05	1.6	— .5	— .6	— .3	.9
28	1.7	2.5	1.1	.2	1.8	6.6	4.0	1.5	— .7	— .5	— .6	1.1
29	1.7	.....	.6	.2	2.2	7.3	3.9	1.5	— .7	— .5	— .6	1.1
30	1.5	.....	.6	.2	2.55	7.2	3.75	1.3	— .8	— .4	— .9	1.1
31	1.6	.....	.7	.....	2.9	.....	3.6	1.2	.....	— .3	.....	1.5

NOTE.—River frozen entirely across January 4 to March 6; ice gradually broke up March 7–22; river clear of ice March 24. Gage heights January 1 to March 7 are to top of ice; after that date to water surface. The following comparative readings were also made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 15	2.0	2.1	2.6
February 18	1.6	1.7	2.8
February 23	1.9	2.0	2.8
February 27	2.4	2.5	2.0

River frozen November 30 to December 31. Average thickness of ice, 1 foot. Gage heights are to top of ice.

Station rating table for Missouri River near Bismarck, N. Dak., from September 28, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
−0.90	7,680	0.50	10,660	1.90	15,780	4.60	31,800
−0.80	7,810	0.60	10,960	2.00	16,240	4.80	33,260
−0.70	7,950	0.70	11,260	2.20	17,180	5.00	34,760
−0.60	8,110	0.80	11,580	2.40	18,160	5.20	36,280
−0.50	8,280	0.90	11,900	2.60	19,200	5.40	37,840
−0.40	8,460	1.00	12,240	2.80	20,280	5.60	39,440
−0.30	8,660	1.10	12,580	3.00	21,400	5.80	41,060
−0.20	8,880	1.20	12,940	3.20	22,560	6.00	42,700
−0.10	9,100	1.30	13,320	3.40	23,760	6.50	46,940
0.00	9,340	1.40	13,700	3.60	25,000	7.00	51,300
0.10	9,580	1.50	14,100	3.80	26,280	7.50	55,780
0.20	9,840	1.60	14,500	4.00	27,600	8.00	60,320
0.30	10,100	1.70	14,920	4.20	28,960		
0.40	10,380	1.80	15,340	4.40	30,360		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 and one in 1904, and is fairly well defined between gage heights −0.6 foot and 7 feet.

Estimated monthly discharge of Missouri River near Bismarck, N. Dak., in 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904				
October	10,660	9,340	10,160	624,700
November	12,240	9,340	10,400	618,800
December	28,280	9,340	16,730	1,029,000
1905				
March 24-31	35,520	10,960	16,640	264,000
April	11,580	9,340	10,200	606,900
May	20,840	9,580	13,640	838,700
June	59,440	23,460	46,030	2,739,000
July	58,520	25,000	41,020	2,522,000
August	33,260	12,940	21,490	1,321,000
September	11,900	7,810	9,696	577,000
October	10,380	7,680	8,440	519,000
November	9,580	7,680	8,710	518,300
The period				9,906,000

MISSOURI RIVER AT KANSAS CITY, MO.

This station was established April 13, 1905. It is located at the Hannibal Railway bridge at the foot of Broadway street, Kansas City, Mo.

The channel is slightly curved for one-half mile or more above and below the station. The right bank is high, is covered with railroad tracks and buildings, and does not overflow at this point; the left bank is low, sandy, somewhat timbered, and is liable to overflow. The bed of the stream is composed of sand and is clean except for stones around the piers and some drift lodged in the bed next to the south bank. The drift does not greatly affect the accuracy of measurements; the piers are the principal disturbing influence. The velocity is medium, becoming sluggish toward the north bank. It is very difficult to secure discharge measurements at this point at high stages on account of the great velocity of the current.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is at the south end on the downstream side of the bridge.

The gage was read from April 13 to June, 1905, by Charles Sprikle; on the latter date arrangements were made under which the readings are furnished by the United States Weather Bureau. The gage is the Missouri River Commission gage, located 280 feet north of the south end of the bridge, on the downstream side. It is graduated in feet and tenths from 303.5 to 332.0 feet, this being elevation above St. Louis, Mo. To obtain gage heights 303.5 feet must be deducted from all readings on this gage.[a]

Discharge measurements of Missouri River at Kansas City, Mo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[b]	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 13	W. G. Russell	704	11,900	3.80	8.6	45,200
May 29	do	856	17,170	4.67	12.2	80,240
June 2	Murphy and Russell	983	20,220	6.48	14.9	130,900
June 29	W. G. Russell	945	23,960	5.75	16.5	137,800
July 8	J. C. Stevens	992	23,840	7.54	19.4	179,800
October 8	W. G. Russell	679	13,610	2.49	7.4	33,830
October 27	do	679	13,750	2.50	7.6	34,360

[a] This was the amount used by the Missouri River Commission. The Weather Bureau deducts 303.3 feet, and this amount has been used since July 1, in order to avoid much unnecessary work and the danger of mistakes. The difference seems to occur from a difference in elevation given by two lines of levels run from St. Louis to this point.

Tuttle & Pike, civil engineers, of Kansas City, give the slope of the Missouri at the Hannibal bridge as 0.80 foot per mile. In 1881 a survey from Leavenworth to Lexington, 76 miles, gave 0.78 foot per mile. In 1903 a survey from the Great Western Railway bridge, just above the mouth of Kansas River, to Hannibal bridge, gave 1.62 feet per mile. In 1904 this slope was 1.22 feet per mile. Tuttle & Pike consider the last two abnormal and 0.80 foot per mile correct at Hannibal bridge.

[b] Gage heights obtained by subtracting 303.5 from gage readings.

Daily gage height, in feet, of Missouri River at Kansas City, Mo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.55	10.0	14.42	17.2	14.2	8.5	9.25	7.2	8.45
2	11.8	9.8	14.9	18.0	14.2	8.5	9.0	7.1	8.1
3	10.87	9.35	14.65	19.7	13.9	8.3	8.7	7.05	7.45
4	10.32	9.18	14.0	20.0	13.5	7.7	8.5	6.95	6.4
5	9.82	9.78	13.42	19.5	13.0	7.6	8.25	7.0	4.7
6	9.42	8.7	13.28	18.8	12.7	7.4	8.05	7.3	4.65
7	9.15	8.82	13.18	18.8	13.4	7.6	7.7	7.85	4.85
8	8.8	8.85	13.08	19.2	13.2	7.5	7.65	9.3	5.75
9	8.72	9.2	13.8	20.4	13.5	7.3	7.35	9.75	6.25
10	8.65	9.45	12.35	22.0	13.5	7.4	7.25	9.3	5.9
11	8.58	9.55	12.3	22.8	12.7	7.3	7.1	8.85	5.6
12	8.52	11.12	11.9	23.0	11.9	7.2	7.1	8.55	5.8
13	8.58	12.65	11.6	22.1	11.4	7.0	7.0	8.35	6.05
14	8.3	13.6	11.8	20.2	11.1	7.2	6.9	8.15	6.25
15	8.25	13.5	12.4	18.7	10.8	11.1	6.75	7.95	6.2
16	8.07	15.6	15.2	17.9	10.9	14.7	6.65	7.65	6.05
17	8.02	16.55	15.5	17.1	11.3	16.6	6.75	7.5	6.2
18	7.85	15.78	15.7	16.5	11.1	17.3	6.8	7.5	6.15
19	8.65	14.78	15.1	15.7	11.7	18.6	7.05	7.45	6.35
20	7.5	13.98	15.0	15.5	12.5	17.1	7.1	7.65	6.4
21	7.48	13.5	15.8	15.2	12.4	15.9	7.45	7.7	6.4
22	7.4	13.15	16.3	14.7	12.1	14.8	8.05	7.45	6.4
23	8.15	12.68	16.1	14.3	11.9	15.1	8.1	7.2	6.4
24	8.72	12.2	16.1	14.1	12.0	13.8	8.0	7.65	6.45
25	9.42	12.88	16.4	13.7	11.6	12.5	8.05	8.15	6.65
26	9.52	14.95	16.5	13.6	10.8	11.7	8.1	8.65	6.4
27	9.58	14.2	17.3	13.7	10.1	11.0	7.8	8.55	6.3
28	9.85	12.65	17.2	13.2	9.6	10.3	7.55	8.35	6.4
29	10.45	12.32	16.7	13.1	9.2	9.8	7.35	8.45	6.25
30	10.45	12.55	16.7	14.0	9.0	9.2	7.3	8.55	6.3
31	.....	12.52	.....	14.5	8.75	.....	7.3	.....	6.25

Station rating table for Missouri River near Kansas City, Mo., from April 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.60	16,000	6.70	28,600	8.80	45,600	12.80	87,800
4.70	16,500	6.80	29,300	8.90	46,500	13.00	90,300
4.80	17,000	6.90	30,000	9.00	47,400	13.50	96,700
4.90	17,500	7.00	30,700	9.20	49,200	14.00	103,200
5.00	18,000	7.10	31,400	9.40	51,100	14.50	109,750
5.10	18,550	7.20	32,100	9.60	53,000	15.00	116,600
5.20	19,100	7.30	32,850	9.80	55,000	15.50	123,600
5.30	19,650	7.40	33,600	10.00	57,000	16.00	130,600
5.40	20,200	7.50	34,400	10.20	59,000	16.50	137,600
5.50	20,750	7.60	35,200	10.40	61,000	17.00	144,600
5.60	21,300	7.70	36,000	10.60	63,000	17.50	151,600
5.70	21,900	7.80	36,800	10.80	65,000	18.00	159,000
5.80	22,500	7.90	37,650	11.00	67,100	18.50	166,500
5.90	23,150	8.00	38,500	11.20	69,200	19.00	174,000
6.00	23,800	8.10	39,350	11.40	71,400	19.50	181,500
6.10	24,450	8.20	40,200	11.60	73,700	20.00	189,000
6.20	25,100	8.30	41,100	11.80	76,000	21.00	204,400
6.30	25,800	8.40	42,000	12.00	78,300	22.00	220,000
6.40	26.500	8.50	42,900	12.20	80,600	23.00	236,000
6.50	27.200	8.60	43,800	12.40	83,000		
6.60	27,900	8.70	44,700	12.60	85,400		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made durin' 1905, and is fairly well defined between gage heights 7 feet and 20 feet.

Estimated monthly discharge of Missouri River near Kansas City, Mo., for 1905.

[Drainage area, 492,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	84,800	33,600	48,990	2,915,000	0.100	0.112
May	138,300	44,700	81,170	4,991,000	.165	.190
June	148,800	73,700	111,800	6,653,000	.227	.253
July	236,000	91,550	150,800	9,272,000	.307	.354
August	105,800	45,150	77,740	4,780,000	.158	.182
September	168,000	30,700	71,000	4,225,000	.144	.161
October	49,680	28,250	35,560	2,185,000	.072	.083
November	54,500	30,350	38,520	2,292,000	.078	.087
December	42,450	16,250	25,750	1,583,000	.052	.060
The period				38,900,000		

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements were made in the Missouri River basin in 1905:

Miscellaneous discharge measurements made in Missouri River drainage basin in 1904 and 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
1904.							
June 5	Little Sioux	Cherokee, Iowa	137	1,232	2.07		2,558
1905.							
June 25	Missouri	Mannhaven, N.Dak.	1,435	9,200	5.65	7.68	52,000
May 30	do	Great Falls, Mont.		1,876	3.24		6,100
June 15	do	do	961	2,645	4.66		12,330
October 7	do	do	961	1,082	1.80		1,951
June 19	Sixteenmile Creek	Lombard, Mont.		50	1.07		53
August 16	do	do		23	.85		19
September 22	do	do		17	.93		16

SMITH RIVER DRAINAGE BASIN.

SMITH RIVER AT TRULY, MONT.

Smith River rises in the Castle Mountains, in southern Meagher County, Mont., flows northwestward, and enters the Missouri about 15 miles southwest of Great Falls.

The gaging station was established March 7, 1905. It is located at a steel highway bridge on the county road running up Smith River valley, in the center of sec. 35, T. 19 N., R. 2 E., Montana prime meridian, near the discontinued post-office of Truly, and about 20 miles southwest of Great Falls, Mont., whence it is reached by driving.

The channel is straight for 200 feet above and 1,200 feet below the station. Both banks are high, but the left may overflow in extremely high water. The bed of the stream is composed of gravel and flat pieces of sandstone, is free from vegetation, and is permanent. There is but one channel at all stages and the current is fairly swift.

Discharge measurements are made from the downstream side of the bridge, which has but one span, though there is a trestle approach at the left bank. The initial point for soundings is marked with white paint on the end post of the truss on the left side of the bridge just above the hand rail.

The gage, which is read twice each day by Henry V. Evans, was originally a vertical rod set into the bed of the stream and braced to the downstream side of the bridge. This was replaced May 11, 1905, by a standard chain gage fastened to the upstream hand rail of the bridge, the same datum being used. The length of the chain is 20.40 feet. The gage is referred to bench marks as follows: (1) A point marked in black paint on the southwest corner of the stone abutment, at the north end of the bridge; its elevation is 12.61 feet above the zero of the gage and approximately 3,400 feet above sea level. (2) A nail in the trunk of a large cottonwood tree at the end of the southwest approach to the bridge, 70 feet back from the initial point for soundings on the downstream side of the road; elevation above gage zero, 13.36 feet.

Discharge measurements of Smith River at Truly, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
March 7	Porter and Bird	87	119	1.37	1.80	163
May 11	Stockman and Porter	81	101	1.24	1.62	125
September 1	A. P. Porter	.....	40	.76	1.20	31

Daily gage height, in feet, of Smith River at Truly, Mont., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.58	1.6	1.9	2.15	1.7	1.25	1.28	1.43	1.38
2	.....	1.58	1.55	1.9	2.15	1.75	1.28	1.3	1.45	1.4
3	.....	1.6	1.6	1.88	2.1	1.8	1.23	1.3	1.45	1.4
4	.....	1.55	1.6	1.95	2.05	1.65	1.25	1.35	1.53	1.58
5	.....	1.58	1.6	2.05	2.0	1.6	1.23	1.32	1.53	1.6
6	.....	1.55	1.5	2.15	1.92	1.6	1.23	1.3	1.55	1.62
7	1.8	1.58	1.5	2.2	1.88	1.55	1.2	1.3	1.55	1.55
8	1.78	1.6	1.55	2.2	1.85	1.5	1.22	1.3	1.55	1.58
9	1.8	1.7	1.5	2.15	1.85	1.5	1.2	1.3	1.55	1.6
10	1.8	1.55	1.58	2.35	1.75	1.48	1.2	1.3	1.55	1.58
11	1.65	1.55	1.68	2.55	1.72	1.4	1.2	1.32	1.55	1.52
12	1.65	1.6	1.75	2.65	1.65	1.4	1.2	1.35	1.55	1.52
13	1.52	1.5	1.65	2.45	1.6	1.4	1.18	1.4	1.55	1.5
14	1.45	1.58	1.65	2.35	1.6	1.4	1.18	1.4	1.55	1.5
15	1.75	1.6	1.6	2.3	1.6	1.4	1.18	1.4	1.55	1.52
16	1.75	1.6	1.6	2.28	1.6	1.4	1.2	1.4	1.55	1.5
17	1.75	1.6	1.58	2.17	1.68	1.4	1.18	1.42	1.55	1.5
18	1.75	1.6	1.6	2.2	1.6	1.4	1.18	1.45	1.55	1.4
19	1.75	1.6	1.8	2.12	1.6	1.4	1.18	1.45	1.55	1.4
20	1.72	1.6	1.88	2.0	1.62	1.32	1.18	1.32	1.55	1.48
21	1.72	1.6	1.85	2.0	1.6	1.3	1.18	1.4	1.55	1.55
22	1.7	1.6	1.85	2.0	1.6	1.3	1.15	1.4	1.55	1.7
23	1.68	1.6	1.95	2.25	1.58	1.3	1.15	1.5	1.45	1.6
24	1.65	1.6	1.9	2.35	1.52	1.3	1.15	1.5	1.3	1.5
25	1.65	1.6	1.9	2.4	1.5	1.3	1.15	1.53	1.33	1.4
26	1.52	1.6	1.9	2.48	1.5	1.3	1.15	1.5	1.35	1.45
27	1.62	1.6	1.9	2.52	1.52	1.3	1.15	1.53	1.3	1.45
28	1.62	1.6	1.9	2.4	1.85	1.3	1.15	1.5	1.38	1.35
29	1.65	1.6	1.9	2.28	1.72	1.3	1.18	1.53	1.25	1.45
30	1.62	1.6	1.9	2.2	1.65	1.28	1.25	1.65	1.28	1.4
31	1.55	.....	1.9	.....	1.6	1.25	.....	1.5	.....	1.35

NOTE.—Practically open-channel conditions during December.

SUN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Sun River rises on the eastern slope of the Rocky Mountains in northwestern Montana, flows southward for about 60 miles, then, turning abruptly, flows eastward through a canyon in the confining mountains, emerging on a level plain through which it runs for 75 miles to its junction with the Missouri at Great Falls. The basin lies between Teton River on the north, the Dearborn on the south, the Missouri on the east, and the crest of the main range of the Rockies on the west.

Along its entire course through the plain the river has eroded a broad, level bottom, which averages about 1 mile in width and is from 5 to 25 feet above the surface of the water in the river. This bottom is bordered by a steeply sloping bluff, ranging in height from 300 to 500 feet, the top being the level surface of the plain, which extends north and south as a generally flat bench to the next river channel, where a similar bluff and bottom appear.

A project for reclaiming the bench lands between Sun and Teton rivers is under consideration by the United States Reclamation Service, and for that reason gaging stations have been maintained by the United States Geological Survey during 1905.

Information in regard to this basin is contained in the Annual Reports of the Reclamation Service and in the Annual Reports of the United States Geological Survey as follows:

Description: 11, ii, pp 43.
Irrigation surveys: 11, ii, pp 120–133; 13, iii, pp 56–57, 371–386.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

This station was established October 31, 1903. It is located below the head of the Kilraven ditch, near Christian's ranch, 14 miles northwest of Augusta and 21 miles southwest of Choteau, Mont.

The channel is straight for about 200 feet below and 300 feet above the station. The right bank is low and may overflow at flood stages; the left bank is high and rocky. The bed of the stream is of solid rock. The current is sluggish.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the left cable support.

A standard chain gage, which, since March 1, 1905, has been read daily by G. B. Christian, who lives about one-half mile from the gage, is located on the left bank about 250 feet below the cable. The horizontal scale board is painted white and is fastened to three posts set in the ground. The length of the chain is 13.02 feet. The distance from the outside edge of the pulley to the zero of the scale is 4.00 feet. The gage is referred to bench marks as follows: (1) The highest point on a rock in the river, 12 feet upstream from the gage; size of the rock, 4 cubic yards; elevation of bench mark above gage zero, 3.96 feet. (2) A nail in the root of a cottonwood tree 15 feet east of the gage; elevation, 14.47 feet above gage zero. (3) A nail in the post which supports the inshore end of the gage; elevation, 10.69 feet above gage zero.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 99, pp 116–117; 130, p 90.
Discharge monthly: Ann 11, ii, p 94; 12, ii, pp 347, 360; 13, iii, p 93; 130, p 90.
Discharge, yearly: Ann 13, iii, p 98; 20, iv, p 53.
Gage heights: WS 130, p 90.
Hydrograph: Ann 12, ii, p 234.

Discharge measurements of North Fork of Sun River near Augusta, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 7	L. R. Stockman	115	357	1.41	1.34	502
May 24	Porter and Robbins	135	508	2.63	2.36	1,335
June 6	A. P. Porter	143	769	5.00	3.99	3,842
June 7	do	143	772	5.01	4.01	3,860
September 25	Gordon Edson	86	92	2.21	.70	205

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.7	0.5	1.2	3.4	2.2	1.4	0.8	0.7	0.7	1.0
2	.65	.5	1.2	3.9	2.4	1.3	.8	,7	,7	1.0
3	.65	.5	1.3	4.0	2.4	1.3	.8	.7	.7	1.0
4	.6	.5	1.3	4.0	2.4	1.3	.8	.7	.6	1.0
5	.6	.5	1.3	3.9	2.4	1.3	.8	.7	.6	1.0
6	.65	.5	1.3	4.1	2.3	1.3	.8	.7	.6	1.0
7	.65	.5	1.3	4.0	2.3	1.2	.8	.7	.6	1.0
8	.65	.5	1.7	3.9	2.3	1.2	.8	.7	.6	1.0
9	.7	.7	2.2	3.9	2.0	1.2	.8	.7	.6	1.0
10	.7	.9	2.1	3.5	1.9	1.2	.8	.7	.6	1.0
11	.65	.9	1.9	3.4	1.9	1.2	.8	.7	.6	1.0
12	.6	.8	1.8	3.5	1.8	1.1	.8	.7	.6	1.0
13	.6	.8	1.8	3.5	1.7	1.1	.8	.7	.6	1.0
14	.6	.8	2.0	3.2	1.8	1.1	.8	.7	.6	1.0
15	.6	.8	2.0	3.0	1.9	1.1	.8	.7	.6	1.0
16	.6	.7	2.2	2.8	1.6	1.1	.8	.7	.6	1.0
17	.6	.7	2.2	2.6	1.6	1.0	.8	.7	.6	1.0
18	.6	.8	2.4	2.4	1.5	1.0	.8	.7	.6	1.0
19	.6	.8	2.5	2.3	1.5	1.0	.8	.7	.6	1.0
20	.6	.8	2.7	2.2	1.5	.9	.8	.7	.6	1.0
21	.6	.8	2.9	2.3	1.4	.9	.8	.7	.6	1.0
22	.6	.9	2.7	2.3	1.4	.9	.8	.7	.6	1.0
23	.6	1.0	2.5	2.3	1.4	.9	.8	.7	.6	1.0
24	.6	1.3	2.4	2.3	1.4	.9	.7	.7	.6	.9
25	.6	1.5	2.4	2.3	1.4	.9	.7	.7	.6	.9
26	.6	1.6	2.4	2.3	1.3	.9	.7	.7	.6	.9
27	.6	1.5	2.4	2.3	1.3	.8	.7	.7	1.0	.9
28	.6	1.3	2.3	2.3	1.3	.8	.7	.7	1.0	.9
29	.6	1.3	2.4	2.3	1.4	.8	.7	.7	1.0	.9
30	.7	1.3	2.5	2.2	1.3	.8	.7	.7	1.0	.9
31	.6	.....	3.0	.....	1.4	.8	.....	.7	.....	.9

NOTE.—Readings to top of ice November 27 to December 23.

Station rating table for North Fork of Sun River near Augusta, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	125	1.40	537	2.30	1,280	3.20	2,410
0.60	161	1.50	602	2.40	1,380	3.30	2,570
0.70	199	1.60	672	2.50	1,485	3.40	2,740
0.80	239	1.70	747	2.60	1,595	3.50	2,920
0.90	281	1.80	827	2.70	1,710	3.60	3,100
1.00	325	1.90	912	2.80	1,830	3.70	3,280
1.10	372	2.00	1,002	2.90	1,960	3.80	3,470
1.20	422	2.10	1,092	3.00	2,100	3.90	3,670
1.30	477	2.20	1,185	3.10	2,250	4.00	3,870

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1904–5. It is well defined between gage heights 0.6 foot and 2.5 feet, and above 2.5 feet is based on two flood measurements at 10 feet.

Estimated monthly discharge of North Fork of Sun River near Augusta, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	199	161	170	10,450
April	672	125	282	16,780
May	2,100	422	1,119	68,800
June	4,070	1,185	2,303	137,000
July	1,380	477	823	50,600
August	537	239	356	21,890
September	239	199	230	13,690
October	199	199	199	12,240
November 1-26	199	161	165	9,818
December 24-31	281	281	281	4,459
The period				345,700

NOTE.—No estimate for ice period.

SOUTH FORK OF SUN RIVER, AT AUGUSTA, MONT.

This station was established December 2, 1904. It is located at the highway bridge on the road from Augusta to Craig, Mont., about one-half mile from Augusta.

The channel above the station is straight for 20 feet and then turns to the right; below the station it is straight for 30 feet and then forks into two branches. Both banks are high and not liable to overflow. The bed of the stream is composed of coar e gravel and cobblestone. The current is sluggish. Two sloughs on the east side and an irrigation ditch on the west side of the bridge carry water past the point of measurement.

Discharge measurements are made from the upstream side of the single-span bridge. The initial point for soundings is at the east end of the hand rail, directly over the face of the right abutment.

The gage, which is read daily by Richard Auchard, is a vertical rod spiked to the crib work of the east or right abutment on the downstream side. The gage is referred to bench marks as follows: (1) The head of a spike surrounded by a ring of nails in the top of the east abutment on the downstream side; elevation, 4.89 feet. (2) A spike in the root of a large cottonwood tree 75 feet west of the west end of the bridge on the north side of the road; elevation, 4.63 feet. Elevations are above zero of gage.

A description of this station, with gage-height and discharge data, is contained in Water Supply Paper No. 130 of the United States Geological Survey, page 90.

Discharge measurements of South Fork of Sun River at Augusta, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 6	Stockman and Porter	26	33	0.47	0.72	16
May 26	A. P. Porter	32	52	1.25	1.27	66
June 5	do	70	107	3.51	2.14	375
August 25	Porter and Edson	31	20	.63	.59	13
November 1	Gordon Edson	18	7.9	.70	.45	5.5

Daily gage height, in feet, of South Fork of Sun River at Augusta, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.6	1.1	1.0	1.0	1.8	1.9	1.9	0.5	0.6	0.4	1.6
2	1.3	1.8	1.1	1.0	.9	1.7	1.9	1.5	.5	.6	.5	1.6
3	1.2	1.8	1.1	1.0	1.0	1.7	1.8	1.4	.55	.6	.6	1.6
4	1.15	1.8	1.0	1.0	1.0	1.7	1.7	1.3	.6	.7	.6	1.6
5	1.3	1.8	1.0	.9	1.0	2.0	1.7	1.3	.65	.7	.6	1.6
6	1.15	1.9	1.0	.9	1.0	2.1	1.7	1.3	.6	.7	.6	1.6
7	1.2	1.9	1.0	.9	1.0	2.35	1.6	1.2	.6	.8	.7	1.6
8	1.3	1.9	1.0	.9	.6	2.1	1.6	1.2	.6	.8	.7	1.6
9	.....	1.9	1.0	.9	.8	2.45	1.5	1.1	.6	.8	.7	1.6
10	.....	1.9	1.0	.9	1.0	2.4	1.4	1.1	.6	.8	.7	1.6
11	.....	1.9	1.0	.9	1.0	2.4	1.4	1.1	.6	.8	.7	1.6
12	.....	1.9	1.0	.9	1.0	2.25	1.4	1.0	.6	.8	.7	1.6
13	.....	1.9	.9	.9	1.0	2.1	1.35	1.0	.6	.8	.7	1.6
14	.....	1.9	1.1	1.0	1.0	2.1	1.2	1.0	.6	.8	.7	1.4
15	.....	1.9	1.05	.95	1.1	2.0	1.2	1.0	.6	.8	.8	1.4
16	.....	1.9	1.05	.95	1.1	1.9	1.2	.9	.6	.8	.8	1.4
17	.....	2.0	1.05	1.0	1.2	1.78	1.1	.9	.5	.9	.8	1.2
18	.....	2.0	1.05	1.0	1.3	1.7	1.1	.9	.5	.9	.8	1.2
19	.....	2.1	1.1	1.0	1.2	1.65	1.1	.9	.5	.9	.8	1.2
20	.....	2.1	1.1	1.05	1.2	1.6	1.1	.9	.5	.7	.9	.9
21	.....	2.1	1.0	1.0	1.2	1.55	1.1	.8	.5	.8	.9	1.3
22	.....	2.1	1.1	1.0	1.2	1.55	1.0	.8	.5	.8	1.2	1.4
23	.....	2.1	1.0	1.0	1.2	1.62	1.0	.6	.5	.8	1.2	1.4
24	1.6	2.0	1.0	1.0	1.2	1.68	1.0	.6	.5	.7	1.3	1.5
25	.....	1.9	1.0	1.0	1.2	1.78	.9	.6	.5	.7	1.3	1.5
26	.....	1.9	1.0	1.0	1.2	2.2	.9	.6	.5	.6	1.3	1.5
27	.....	1.9	1.0	1.0	1.3	2.2	.9	.6	.6	.6	1.3	1.5
28	.....	1.1	1.0	1.0	1.4	2.05	1.0	.55	.6	.6	1.4	1.5
29	.....	.....	1.0	.9	1.5	2.0	1.0	.5	.6	.6	1.4	1.5
30	.....	.....	1.0	1.0	1.7	1.98	1.0	.5	.6	.4	1.4	1.5
31	.....	.....	1.0	.....	1.7	.....	1.0	.5	.....	.5	.....	1.5

NOTE.—River frozen and readings to surface of ice January 9 to February 27, inclusive, and November 22 to December 31, inclusive.

Station rating table for South Fork of Sun River at Augusta, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	4	1.00	37	1.60	130	2.10	370
0.50	7	1.10	46	1.70	160	2.20	430
0.60	11	1.20	58	1.80	200	2.30	490
0.70	16	1.30	73	1.90	250	2.40	550
0.80	22	1.40	90	2.00	310	2.50	620
0.90	29	1.50	110				

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1904-5. It is fairly well defined between gage heights 0.5 foot and 1.2 feet; above this point it is based on one measurement at 2.14 feet.

Estimated monthly discharge of South Fork of Sun River at Augusta, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	46	29	39.4	2,423
April	42	29	34.2	2,035
May	160	11	56.4	3,468
June	585	120	295	17,550
July	250	29	85.5	5,257
August	250	7	43.4	2,669
September	14	7	9.4	559
October	29	4	18.0	1,107
November 1-21	29	4	16.7	696
The period				35,760

NOTE.—No estimate for ice period.

SUN RIVER AT SUN RIVER, MONT.

This station was established July 31, 1905. It is located at the highway bridge at Sun River, Mont., 21 miles west of Great Falls, and is used for the purpose of checking the measurements of the river and the ditches above.

The channel is slightly curved above the station and straight for 100 yards below. Both banks are high and will overflow only at extreme flood stages. The bed of the stream is composed of loose and coarse gravel. The flow is comparatively swift, but there is some backwater effect near the left bank.

Discharge measurements are made from the lower side of the bridge, which has two spans of 100 feet each. The initial point for soundings is the hand rail over the downstream pier at the left bank. Low-water measurements are made by wading at a point 100 feet above the bridge.

Until September 27, 1905, the gage was read occasionally by different employees of the United States Reclamation Service; on the latter date R. A. Lange was employed as a temporary observer, and observations were made daily to the end of the year. The first gage consisted of a strip of galvanized iron nailed to a pile near the left bank of the river 150 feet above the bridge. August 16, 1905, this was replaced by a vertical rod gage fastened to the same pile, and the datum of the gage was lowered 1.52 feet. The gage is referred to bench marks as follows: (1) A nail on the corner of the house nearest the gage; elevation, 14.16 feet. (2) The bottom of the outer eyebar in the lower chord of the bridge, 3 feet from the first panel point from the left (north) end of the bridge, on the upstream side; elevation, 13.90 feet. Elevations are above the datum of the gage.

Discharge measurements of Sun River at Sun River, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 31	A. P. Porter	91	180	2.38	2.52	427
August 14	do	60	85	3.42	2.10	289
September 27	Gordon Edson	53	43	2.15	1.44	92

Daily gage height, in feet, of Sun River at Sun River, Mont., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				1.45	2.0	2.05	17			1.6	1.85	2.05	2.0
2				1.4	2.0	2.05	18		1.9	1.6	1.9	2.05	2.0
3				1.55	2.0	2.05	19			1.6	1.7	2.0	2.0
4				1.82	2.0	2.05	20			1.5	2.0	2.0	2.0
5				1.82	2.0	2.05	21			1.5	2.1	2.0	2.0
6				1.85	2.0	2.05	22			1.5	2.1	2.0	1.9
7				1.85	2.0	2.05	23			1.4	2.1	2.0	1.9
8				1.85	2.0	2.05	24			1.5	2.0	2.0	2.0
9				1.82	2.0	2.05	25			1.5	2.1	2.0	2.0
10		2.21		1.9	2.0	2.05	26		1.8	1.5	2.0	2.0	2.0
11				1.9	2.0	2.0	27			1.5	2.0	2.0	2.0
12				1.85	2.0	2.0	28		1.8	1.5	2.1	2.05	2.0
13				1.9	2.0	2.0	29			1.45	2.0	2.05	2.0
14		2.1		1.9	2.0	2.0	30		1.75	1.45	2.0	2.05	2.0
15				1.9	2.0	2.0	31	2.52			2.1		2.0
16		2.03		1.9	2.05	2.0							

NOTE.—Gage heights all referred to datum established August 16, 1905. River frozen December 2–16; readings to water surface. Ice 4 inches thick December 11.

Estimated monthly discharge of Sun River at Sun River, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
August (7 days)	323	180	239	14,700
September (17–30)	137	80	110	6,545
October	288	80	224	13,770
November	272	256	259	15,410
December	272	225	259	15,920
The period				66,340

NOTE.—These estimates are only approximate owing to lack of measurements.

WILLOW CREEK NEAR AUGUSTA, MONT.

Willow Creek rises in the northern part of Lewis and Clarke County, and flows northeastward into North Fork of Sun River.

The gaging station was established June 8, 1905. It is located at Jordan's ranch, just below the junction of Willow Creek with Little Willow Creek, about 8 miles northwest of Augusta, Mont., in sec. 27, T. 21 N., R. 7 W., from which it is reached by driving.

The channel is straight for 200 feet above and 40 feet below the station. Both banks are fairly high and the left is thickly wooded. The bed of the stream is composed of clean, hard gravel, with an occasional bowlder. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the old wooden footbridge, having a span of 19 feet. The initial point for soundings is directly over the face of the left abutment of the bridge. Low-water measurements are made by wading just above the gage.

Daily gage readings are taken by S. N. Jordan, who lives about 200 yards away. The original gage was a rod located on the left bank of the stream 30 feet above the measuring bridge. August 22, 1905, a standard chain gage was installed on the bank near the rod gage and made to read the same as the latter. The horizontal arm is fastened to three posts set in the bank. The length of the chain is 14.03 feet. The gage is referred to bench

marks as follows: (1) A nail in the head of a 2 by 4 inch stake driven nearly flush with the ground on the top of a little hill on the left side of the path leading from the gage reader's house to the gage; elevation, 9.25 feet. (2) A point on a log on the left abutment, downstream side of the bridge; elevation, 2.86 feet. (3) The zero of the old gage rod, which is just level with the zero of the chain gage. Elevations are above the datum of the gage.

Discharge measurements of Willow Creek near Augusta, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 8	Porter and Casen	13	38	1.55	2.12	58
July 13	H. P. Porter	17	12	1.95	1.19	23
August 22	Porter and Edson	16	8	1.43	.95	12
November 2	Gordon Edson	14	4	.77	.61	3

Daily gage height, in feet, of Willow Creek near Augusta, Mont., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.45	2.0	0.9	0.6	0.7	0.65
2		2.3	1.52	.9	.6	.7	.65
3		2.25	1.4	.88	.58	.7	.65
4		2.12	1.38	.88	.58	.7	.65
5		1.95	1.3	.87	.58	.7	.68
6		1.85	1.28	.87	.55	.7	.68
7		1.7	1.2	.85	.55	.7	.7
8	2.15	1.65	1.2	.85	.58	.7	.7
9	2.78	1.6	1.18	.8	.62	.7	.7
10	2.43	1.32	1.12	.78	.62	.8	.7
11	2.22	1.2	1.1	.78	.65	.7	.7
12	2.1	1.18	1.08	.77	.65	.73	.7
13	2.0	1.15	1.08	.77	.65	.75	.7
14	1.9	1.12	1.02	.77	.65	.75	.72
15	1.85	1.05	1.0	.75	.65	.75	.7
16	1.68	1.05	.98	.75	.65	.73	.72
17	1.62	.95	1.0	.75	.65	.73	.75
18	1.5	.92	1.0	.75	.65	.73	.75
19	1.48	.9	1.0	.72	.68	.73	.78
20	1.4	.8	.98	.72	.72	.68	.75
21	1.32	.8	.95	.72	.75	.7	.75
22	1.78	.8	.95	7	.78	.7	.72
23	2.15	.8	.9	.7	.75	.7	.7
24	2.22	.8	.9	.68	.72	.73	.7
25	2.6	.8	.95	.68	.72	.7	.68
26	3.15	.8	.95	.65	.73	.7	.65
27	2.77	.9	.95	.65	.73	.68	.65
28	2.55	.92	.9	.62	.7	.62	.65
29	2.43	1.08	.92	.62	.7	.6	.6
30	2.32	1.1	.9	.6	.7	.6	.6
31		1.18	.9		.7		.6

NOTE.—Practically open-channel conditions during December.

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements made in Sun River drainage basin, Montana, in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
May 30	B. E. and T. Irrigation Ditch.[a]	Augusta		2.8	1.57	4.4
November 7	Ford Creek		14.5	8.7	1.15	10
November 9	North Fork of North Fork of Sun River.	Dam site, reservoir No. 3.	20	36	1.29	47
November 10	South Fork of North Fork of Sun River.	do	47	67	.89	59
November 10	Bear Creek	1 mile above mouth	7	3.1	1.24	3.8

[a] This ditch takes water out of South Fork of Sun River just above the gaging station.

BELT CREEK DRAINAGE BASIN.

BELT CREEK NEAR BELT, MONT.

Belt Creek rises in Little Belt Mountains, flows in a general northerly direction, and enters the Missouri about 15 miles northeast of Great Falls.

The gaging station was established March 18, 1905. It is located at the highway bridge near Belt, Mont., in the NW ¼, NE ¼, sec. 18, T. 20 N., R. 7 E., 20 miles east of Great Falls, from which it is reached by driving.

The channel is straight for 50 feet above and below the station and curves to the right above. Both banks are high and the right bank is slightly wooded above the station. The bed of the stream is composed of rock, is free from vegetation, and is permanent. There is but one channel at all stages. The current is very sluggish, the velocity at low water being so small that current-meter measurements can not be taken.

Discharge measurements are made from the upstream side of the bridge, which consists of a single span. The initial point for soundings is marked with white paint on the upstream side of the bridge just over the face of the right abutment.

The gage is read once each day by Mrs. Anna Epperson. The gage first established was a vertical rod bolted to the second floor beam from the east end of the bridge on the upstream side. May 12, 1905, a standard chain gage was placed on the upstream side of the bridge and made to read the same as the old gage. The length of the chain is 16.86 feet. The gage is referred to bench marks as follows: (1) A black cross painted on top of a stone in the top of the upstream side of the left abutment; elevation, 19.19 feet. (2) A nail in the root of a 14-inch cottonwood tree, 25 feet east of the initial point for soundings, and 20 feet north of the center of the highway; elevation, 10.82 feet. Elevations are above the datum of the gage.

Discharge measurements of Belt Creek near Belt, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 17	Porter and Bird	40	45	0.18	1.59	8.0
May 12	L. R. Stockman	40	47	.17	1.61	7.8
June 11	A. P. Porter	55	160	3.61	3.85	578

Daily gage height in feet, of Belt Creek near Belt, Mont., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Nov.	Dec.
1	.....	1.6	1.6	2.5	3.0	1.9	.....	1.1
2	.....	1.55	1.6	2.6	3.0	2.0	.....	1.1
3	.....	1.55	1.6	2.6	3.0	2.0	.....	1.1
4	.....	1.6	1.6	3.1	2.9	2.0	.....	1.1
5	.....	1.6	1.6	3.15	2.9	2.0	.....	1.1
6	.....	1.6	1.6	3.3	2.8	1.9	.....	1.1
7	.....	1.6	1.6	3.35	2.8	1.8	.....	1.1
8	.....	1.6	1.6	3.5	2.8	1.7	.....	1.1
9	.....	1.6	1.6	3.85	2.5	1.5	.....	1.1
10	.....	1.6	1.6	4.1	2.5	1.45	.....	1.1
11	.....	1.6	1.6	4.05	2.5	1.4	.....	1.1
12	.....	1.6	1.6	3.6	2.5	1.4	.....	1.1
13	.....	1.6	1.6	3.6	2.5	1.4	.....	1.1
14	.....	1.65	1.65	3.6	2.5	1.4	.....	1.1
15	.....	1.65	1.65	3.5	2.5	1.5	.....	1.1
16	.....	1.65	1.65	3.35	2.6	1.4	.....	1.1
17	.....	1.65	1.65	3.3	2.5	1.4	.....	1.1
18	1.6	1.6	1.65	3.2	2.4	1.4	.....	1.1
19	1.6	1.6	1.65	3.1	2.3	1.3	.....	1.1
20	1.6	1.6	1.65	3.0	2.3	1.1	.....	1.1
21	1.6	1.6	1.7	3.0	2.3	(a)	.....	1.1
22	1.6	1.6	1.7	3.0	2.3	.....	.....	1.1
23	1.57	1.6	1.7	3.0	2.0	.....	.....	1.1
24	1.55	1.6	2.0	3.2	2.0	.....	.....	1.1
25	1.55	1.6	2.1	3.5	2.0	.....	.....	1.1
26	1.55	1.6	2.3	3.2	2.0	.....	.....	1.1
27	1.55	1.6	2.3	3.0	2.0	.....	.....	1.1
28	1.55	1.6	2.3	3.1	2.0	.....	.....	1.1
29	1.55	1.6	2.4	3.0	2.0	.....	(a)	1.1
30	1.6	1.6	2.4	3.0	2.0	.....	1.1	1.1
31	1.6	.....	2.4	.....	1.9	.....	.....	1.1

a Dry, August 21 to November 29.

NOTE.—Gage height for December, estimated.

HIGHWOOD CREEK DRAINAGE BASIN.

HIGHWOOD CREEK NEAR HIGHWOOD, MONT.

Highwood Creek rises in the Highwood Mountains, flows northwestward, and enters Missouri River about 30 miles below Great Falls.

The gaging station was established March 19, 1905. It is located at a highway bridge leading up Highwood Creek Valley, at Smith's ranch near Highwood, in sec. 5, T. 20 N., R. 8 E., Montana prime meridian, and 30 miles east of Great Falls, from which it is reached by driving.

The channel is straight for 40 feet above and 30 feet below the station; beyond these limits there are curves and rapids. Both banks are high and the right bank is wooded; neither bank is liable to overflow. The bed of the stream is composed of rocks, is free from vegetation, and is permanent. There is but one channel at all stages and the current is rather swift.

Discharge measurements are made from the upstream side of the two-span pile bridge to which the gage is attached. The initial point for soundings is on the upstream side of the bridge directly over the face of the left abutment.

The gage, which is read twice each day by Richard Smith, consists of a vertical rod, spiked to the cap on the piles at the northwest end of the bridge, upstream side. The gage is

referred to bench marks as follows: (1) The head of a 30-penny spike driven in the end of the pile cap on the center bent of the bridge and marked with a cross in black paint; elevation, 5.83 feet. (2) The underside of the end plank on top of the stringer at the northwest end of the bridge, upstream side; elevation, 7.00 feet. Elevations are above the datum of the gage.

Discharge measurements of Highwood Creek near Highwood, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 19	Porter and Bird	16	9	0.85	0.75	8.0
May 13	Stockman and Porter	16	9	.95	.84	8.0
June 11	A. P. Porter	25	28	3.21	1.78	91.

Daily gage height in feet, of Highwood Creek near Highwood, Mont., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
1		0.75	0.7	1.0	1.15	0.66		0.55	0.6
2		.75	.7	.98	1.1	.65		.56	.59
3		.75	.7	.94	1.08	.52		.58	.6
4		.75	.69	1.0	1.05	.45		.6	.6
5		.75	.7	1.25	1.02	.35		.62	.6
6		.78	.66	1.7	1.02	.32		.61	.61
7		.78	.68	1.65	.98	.41		.6	.62
8		.79	.7	1.58	1.05	.5		.6	.62
9		.82	.75	2.3	1.02	.48		.6	.65
10		.83	.8	2.2	.92	.48		.6	.64
11		.8	.82	1.77	.82	.28		.6	.65
12		.8	.82	1.6	.82	.35		.6	.65
13		.82	.85	1.5	.75	.18		.6	.65
14		.83	.86	1.3	.78	.32		.6	.65
15		.82	.88	1.2	.75	.08		.6	.65
16		.78	.86	1.18	.72	.1		.6	.66
17		.75	.88	1.2	.9	.15		.62	.68
18		.75	.92	1.18	.82	.06		.61	.66
19	0.78	.75	.95	1.1	.8			.62	.68
20	.8	.75	.98	1.1	.78			.61	.66
21	.78	.74	.99	1.05	.75			.62	.65
22	.75	.78	1.02	1.17	.74			.61	.64
23	.75	.8	1.02	1.33	.72			.62	.62
24	.75	.78	1.04	1.3	.7			.61	.61
25	.75	.8	1.05	1.25	.7			.62	.62
26	.75	.81	1.01	1.25	.69			.61	.61
27	.72	.85	1.01	1.28	.7			.62	.62
28	.73	.84	1.01	1.25	.69			.61	.61
29	.72	.72	1.02	1.22	.7		0.2	.62	.62
30	.73	.69	1.04	1.2	.68		.4	.59	.61
31	.75		1.05		.7		.52		.6

NOTE.—No flow August 19 to October 28. Practically open-channel conditions during December.

MARIAS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Marias River rises on the eastern slope of the main divide of the Rocky Mountains and flows in a general southeasterly direction to its junction with the Missouri. Throughout its entire length the river flows in a canyon and has a fall not exceeding 5 feet per mile. Its principal tributaries are Cutbank Creek, Willow Creek, and Cottonwood Creek, which enter from the north, and Two Medicine Creek, Birch Creek, and Teton River from the south. The most important of these is the Teton, which has its source in the Rocky Mountains, flows eastward in a course approximately parallel to that of Sun River, crossing and recrossing the sixth standard parallel north, and emptying into Marias River about a mile above the point where the latter joins the Missouri.

The United States Reclamation Service has under consideration a project for diverting water from the head of St. Mary River across both North and South forks of Milk River to Cutbank Creek, allowing it to flow down this creek and Marias River for 100 miles or more, and then taking it out of the Marias by a canal to Big Sandy Creek, a tributary of Milk River.

Information in regard to stations in this basin is contained in the Annual Reports of the Reclamation Service and in the Thirteenth Annual Report of the United States Geological Survey, Part III, pages 59–60.

MARIAS RIVER NEAR SHELBY, MONT.

This station was established April 4, 1902. It is located at the highway bridge near James A. Johnson's ranch, 7 miles south of Shelby, Mont.

The channel is straight for 100 yards above and 200 yards below the station. The right bank is sandy, sloping, and liable to overflow; the left bank is high and is protected by sheet piling and a plank wall. The bed of the stream is composed of sand and gravel, with some cobblestones, and is liable to shift after freshets. There is but one channel and the current flows toward the left bank as it rounds a sharp curve some distance above. The velocity of the current is moderate.

Discharge measurements are made from the highway bridge, the lower chord of which is about 15 feet above low water. The initial point for soundings is the east end of the bridge pier on the lower side of the bridge at the left bank.

A standard chain gage, which has been read during 1905 by Mr. Johnson, is fastened to the upstream guard rail of the bridge. The length of the chain is 21.98 feet. The gage is referred to bench marks as follows: (1) A rivet head in the footplate at the foot of the batter post on the top of the southeast pier; the plate is marked "B. M. 17.54," which is the elevation above gage datum. (2) A spike in the southwest side of a cottonwood stump, 25 feet southeast of the southeast pier; elevation above gage datum, 11.26 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 32; 99, pp 112-113; 130, p 91.
Discharge: 66, p 23; 84, p 33; 99, p 113; 130, p 91.
Discharge, monthly: 84, p 34; 99, p 115; 130, p 93.
Gage heights: 84, p 33; 99, pp 113-114; 130, p 92.
Rating tables: 84, p 34; 99, p 114; 130, p 92.

Discharge measurements of Marias River near Shelby, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 30	Stockman and Morse	155	362	2.87	2.88	1,040
May 21	H. M. Morse	165	435	3.35	3.42	1,455
June 1	do	166	460	3.50	3.53	1,610
July 11	W. B. Freeman	152	358	2.90	2.92	1,037
August 7	H. M. Morse	135	252	1.46	2.22	369
September 9	W. B. Freeman	122	181	.88	1.78	159
October 17	Freeman and Morse	134	238	1.53	2.22	363
November 20	W. B. Freeman	127	189	1.08	1.88	204

Daily gage height, in feet, of Marias River near Shelby, Mont., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.5	3.4	2.5	.....	.....	2.3	2.0
2	3.9	3.6	3.6	2.4	.....	.....	2.3	2.05
3	4.1	3.5	3.6	2.4	1.85	.....	2.3	2.05
4	4.1	3.6	3.5	2.3	.....	.....	2.25	2.05
5	4.1	3.6	3.4	2.3	.....	.....	2.25	2.0
6	4.0	3.5	3.4	2.3	.....	.....	2.2	2.0
7	3.9	3.4	3.3	2.3	.....	.....	2.2	2.05
8	3.8	3.7	3.2	2.2	.....	.....	2.18	2.05
9	3.7	3.9	3.2	2.2	1.83	.....	2.15	2.07
10	3.7	4.0	3.1	2.2	.....	.....	2.15	2.07
11	3.6	3.7	2.9	2.1	.....	.....	2.1	2.07
12	3.4	3.6	2.9	2.1	.....	.....	2.1	2.07
13	3.4	3.6	2.8	2.1	.....	.....	2.05	2.07
14	3.7	3.7	2.8	2.1	.....	.....	2.05	2.07
15	3.8	3.5	2.7	2.1	.....	.....	2.05	2.1
16	3.8	3.5	2.7	2.0	.....	.....	2.0	2.1
17	3.7	3.6	2.6	2.0	.....	2.22	2.0	2.1
18	3.7	3.5	2.5	2.0	.....	.....	2.0	2.1
19	3.8	3.4	2.5	1.95	.....	.....	2.0	2.1
20	3.6	3.25	2.5	1.9	.....	.....	2.0	2.1
21	3.8	3.3	2.5	1.9	.....	.....	1.95	2.07
22	3.9	3.25	2.5	1.85	.....	.....	1.95	2.07
23	4.1	3.2	2.4	.....	.....	.....	1.9	2.07
24	4.2	3.3	2.4	.....	.....	.....	1.9	2.05
25	4.8	3.4	2.4	.....	.....	.....	1.9	2.05
26	4.9	3.5	2.9	.....	.....	.....	1.9	2.07
27	4.7	3.6	2.5	.....	.....	.....	1.9	2.07
28	3.6	3.5	2.5	.....	.....	.....	1.9	2.07
29	3.5	3.5	3.0	.....	.....	2.4	1.9	2.07
30	3.4	3.4	2.7	.....	.....	2.35	1.95	2.07
31	3.4	.....	2.5	.....	.....	2.35	.....	2.05

NOTE.—No observations from January 1 to April 30 or from August 23 to October 28. Practically open-channel conditions during December.

Station rating table for Marias River near Shelby, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	150	2.60	590	3.50	1,550	4.40	2,970
1.80	180	2.70	670	3.60	1,690	4.50	3,160
1.90	215	2.80	760	3.70	1,830	4.60	3,350
2.00	250	2.90	850	3.80	1,970	4.70	3,540
2.10	290	3.00	950	3.90	2,130	4.80	3,740
2.20	340	3.10	1,050	4.00	2,290	4.90	3,940
2.30	390	3.20	1,170	4.10	2,450	5.00	4,160
2.40	450	3.30	1,290	4.20	2,610		
2.50	520	3.40	1,410	4.30	2,790		

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1904-5, and is well defined between gage heights 1.8 feet and 4.5 feet.

Estimated monthly discharge of Marias River near Shelby, Mont., for 1905.

[Drainage area 2,610 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May	3,940	1,410	2,114	130,000	0.810	0.934
June	2,290	1,170	1,585	94,310	.607	.677
July	1,690	450	870	53,490	.333	.384
August 1-22	520	198	321	14,010	.123	.101
November	390	215	279	16,600	.107	.119
December	290	250	276	16,970	.106	.122
The period				325,400		

CUTBANK CREEK AT CUTBANK, MONT.

Cutbank Creek rises on the eastern slope of the Rocky Mountains, flows eastward and then southeastward, and enters Marias River near the town of Cutbank.

The gaging station was established August 4, 1905. It is located in the gorge just below the steel-trestle bridge of the Great Northern Railway, three-fourths of a mile west of Cutbank.

Except for a slight curve just above, the channel is straight for 500 feet or more above and below the cable. At the cable support the right bank is 3 feet higher than the left, which might overflow at the highest stages; both banks are free from brush and vegetation. The bed of the stream is composed of gravel with an occasional bowlder, and the sides are of sandy soil. Fairly accurate results should be obtained, though the current is rather swift and the bottom somewhat rough. Owing to the distance between the gage and the cable the slope of the water surface at the two points is probably somewhat different.

Discharge measurements are made by means of a cable with tag wire, which was established September 18, 1905, 300 yards below the gage. The initial point for soundings is on the tag wire 5 feet out from the cable support on the left bank.

The gage is read twice each day by Frank Mason. The first gage was a rod placed on the left (east) bank of the creek and nailed to the cribbing at the intake of the railroad pumping plant. This was replaced August 31, 1905, by a standard chain gage, located on the left bank 200 feet below the rod gage and made to read the same as the latter. The

horizontal arm is graduated from 1.5 feet to 10 feet and is supported by posts set in the bank. The distance from the center of the standard gage pulley to the zero of the gage scale is 4.98 feet. The length of the chain is 17.35 feet. The gage is referred to bench marks as follows: (1) A black cross painted on the southwest corner of the yellow sandstone block at the foot of the bedplate on the top of the upstream masonry pier nearest the water's edge at the left bank, of the Great Northern Railway steel-trestle bridge over the creek; elevation, 16.64 feet. (2) A cross chiseled on the highest point of a large outcropping rock at the southeast corner of Frank Mason's house, 75 feet north of the gage; elevation, 15.11 feet. (3) A railroad spike driven in the north side of the rear post of the gage 2 feet above ground; elevation, 11.04 feet. Elevations are above the datum of the gage.

Discharge measurements of Cutbank Creek at Cutbank, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 31	W. B. Freeman	31	18	1.24	2.81	22
September 27	H. M. Morse	26	12	1.04	2.77	12
October 19	Freeman and Morse	48	44	1.33	3.30	58
November 19	W. B. Freeman	42	22	2.14	3.11	47

Daily gage height, in feet, of Cutbank Creek at Cutbank, Mont., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.8	2.85	3.2	2.4	17	3.1	2.8	3.25	3.1	3.7
2	.....	2.8	2.9	3.25	2.45	18	3.1	2.8	3.1	3.1	3.7
3	.....	2.8	2.8	3.2	2.55	19	3.1	2.8	3.3	3.1	3.75
4	3.3	2.8	2.85	3.2	3.35	20	3.0	2.75	3.25	3.1	3.7
5	3.3	2.8	3.15	3.25	2.9	21	3.0	2.7	3.25	3.1	3.55
6	3.3	2.8	3.6	3.25	2.8	22	3.0	2.7	3.25	2.9	3.5
7	3.25	2.8	3.5	3.2	2.8	23	3.0	2.7	3.2	3.0	3.4
8	3.2	2.8	3.5	3.2	2.65	24	3.0	2.7	3.2	3.05	3.35
9	3.2	2.75	3.4	3.2	3.95	25	2.9	2.8	3.2	3.1	3.45
10	3.1	2.7	3.4	3.2	3.95	26	2.9	2.7	3.25	2.95	3.45
11	3.25	2.7	3.4	3.15	4.0	27	2.9	2.8	3.25	2.8	3.65
12	3.2	2.7	3.3	3.1	4.0	28	2.9	2.8	3.3	2.6	3.7
13	3.15	2.7	3.3	3.1	4.0	29	2.8	2.8	3.3	2.5	3.4
14	3.1	2.7	3.3	3.1	3.9	30	2.8	2.85	3.25	2.5	3.3
15	3.1	2.7	3.3	3.1	3.9	31	2.8	.....	3.2	.....	3.4
16	3.1	2.7	3.2	3.1	3.8						

NOTE.—November 26 to December 31 readings were taken through a hole cut in the ice.

TETON RIVER NEAR BELLEVIEW, MONT.

This station was established November 26, 1904. It is located in sec. 35, T. 25 N., R. 35 W., Montana prime meridian, about 16 miles above Choteau, Mont. The nearest post-office is Belleview, Mont.

The channel above the station is straight for about 200 feet at low water, but at high water the river curves gradually from the left; below the station the channel is straight for 75 feet. Both banks are low and covered with thick underbrush and a few scattered trees. The bed of the stream consists of coarse gravel and cobblestones and is free from vegetation. A bar divides the channel at low water. The current is swift and there are some small rapids down the stream.

Discharge measurements are made by means of a cable, car, and tagged wire a short distance upstream from the gage. The initial point for soundings is the zero of the tagged wire at the left bank.

The gage is read daily by Julius Bjornstad, who lives near. The first gage was spiked to a post on the left bank, about 40 feet above the head of Kroff's irrigation ditch. March 9, 1905, it was moved by the observer 250 feet upstream on account of the dam erected at the head of the ditch below. There is no connection between the gage readings before and after that date, probably on account of the difference in slope of the water surface at the two points. May 8, 1905, the gage, which is a rod, was referred to the bench marks, and it was found that the datum had been raised 0.78 foot in moving, while the difference in the level of the water surface at the old and new locations was but 0.10 foot. The gage datum was then lowered 0.20 foot, and it is now 0.58 foot above the original datum. The gage is referred to bench marks as follows: (1) A nail in a 10-inch cottonwood tree 8 feet west of the road and 50 feet from the left bank of the river; elevation, 4.85 feet. (2) A nail in a 5-inch cottonwood tree 2 feet east of the road and 50 feet from the left bank; elevation, 4.45 feet. (3) A nail in a 20-inch cottonwood tree serving as a post in Bjornstad's small corral; elevation, 2.51 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 93–94.

Discharge measurements of Teton River near Belleview, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 8	Stockman and Porter	38	34	1.41	0.40	48
October 12	Gordon Edson		38	1.46	.39	56
November 4	do	36	37	1.38	.38	51

Daily gage height, in feet, of Teton River near Belleview, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.4	0.3	0.15	0.85	0.4	1.3	1.2	0.65	.....	0.4	0.35	0.25
2	.4	.3	.2	.3	.45	1.55	1.2	.7	0.5	.4	.35	.25
3	.4	.3	.2	.3	.4	1.85	1.2	.7	.5	.4	.35	.15
4	.4	.3	.15	.35	.4	1.8	1.2	.7	.....	.35	.4	.0
5	.4	.3	.15	.35	.4	1.8	1.15	.7	.4	.....	.35	.0
6	.4	.3	.15	.35	.4	2.0	1.1	.6	.55	.4	.35	.0
7	.4	.3	.15	.35	.4	2.2	1.1	.65	.45	.4	.35	.0
8	.4	.3	.15	.35	.4	2.2	1.1	.6	.45	.4	.35	.0
9	.4	.3	.35	.3	.5	2.2	1.0	.6	.45	.4	.35	.05
10	.....	.3	.35	.25	.6	2.0	1.0	.6	.4	.4	.35	.05
11	.....	.3	.35	.25	.6	1.8	1.0	.55	.4	.4	.35	.1
12	.....	.3	.35	.25	.6	1.7	1.0	.6	.4	.45	.35	.1
13	.....	.3	.35	.3	.6	1.7	1.0	.6	.4	.5	.35	.1
14	.....	.3	.35	.3	.6	1.6	.95	.6	.4	.45	.35	.1
15	.4	.3	.35	.3	.55	1.45	.9	.6	.4	.45	.35	.1
16	.4	.3	.35	.3	.55	1.4	.9	.....	.4	.45	.35	.05
17	.3	.3	.35	.3	.65	1.4	.85	.....	.4	.45	.35	.05
18	.3	.3	.35	.3	.7	1.3	.8	.5	.4	.45	.35	.05
19	.3	.3	.35	.3	.8	1.2	.8	.5	.4	.3	.35	.05
20	.3	.3	.35	.3	.85	1.15	.75	.5	.4	.35	.35	.05
21	.3	.3	.35	.3	1.0	1.1	.75	.....	.4	.35	.3	.05
22	.3	.3	.3	.3	1.05	1.15	.8	.....	.4	.35	.3	.05
23	.....	.3	.3	.3	1.0	1.2	7	.....	.4	.35	.3	.4
24	.....	.3	.3	.3	.95	1.15	.75	.5	.35	.35	.3	.05
25	.....	.3	.3	.3	.95	1.15	.7	.5	.35	.35	.3	.05
26	.3	.3	.3	.4	.9	1.2	.7	.5	.....	.4	.3	.05
27	.3	.3	.3	.4	.9	1.15	.7	.....	.4	.4	2.3	.0
28	.3	.1	.3	.4	.9	1.15	.7	.5	.4	.4	.25	.0
29	.3	.....	.3	.4	.95	1.15	.7	.....	.4	.4	.25	.0
30	.3	.....	.35	.4	1.0	1.1	.7	.....	.4	.35	.25	.0
31	.3	.....	.35	.....	1.1	.....	.7	.....	.....	.4	.....	.0

NOTE.—Readings from March 9 to December 31 have been referred to the datum of May 8, 1905. The readings prior to March 9 refer to a different datum, there being no connection with the later readings. River partly frozen January 1-22, inclusive; readings to the surface of the ice January 26 to February 27, inclusive. River open after February 28. River blocked with ice November 27 and December 23.

TETON RIVER NEAR CHOTEAU, MONT.

This station was established November 30, 1904. It is located at the highway bridge on the road from Choteau to Augusta, Mont., and is about 1½ miles from the town of Choteau.

The channel is straight for about 200 feet above the station; below it curves slightly to the right. The right bank is high; the left is low and is subject to overflow at high stages. The bed of the stream is covered with rocks and coarse gravel and is free from vegetation. The current is swift.

Discharge measurements are made from the upstream side of the bridge, which is a wooden structure resting on pile bents. The initial point for soundings is at the left side of the bridge.

The gage is read occasionally by J. W. Shields, a surveyor, who performs this service gratuitously. The original chain gage was fastened to the upstream hand rail of the bridge. This was replaced May 9, 1905, by a standard chain gage, fastened to the floor of the bridge near the former gage, the same datum being maintained; the chain length is 12.33 feet. The gage is referred to bench marks as follows: (1) A nail in a 3-inch plank just back of the floor beam at the west end of the bridge; elevation above zero of gage, 9.08 feet. (2) A

nail, 2 feet above ground, in the trunk of a cottonwood tree 100 feet from the east end of the bridge and in the fence on the south side of the road; elevation above gage zero 6.87 feet.

Information in regard to this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 94–95.

Discharge measurements of Teton River near Choteau, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 9	Stockman and Porter	15	5.0	1.54	1.70	8
October 13	Gordon Edson		3.9	.76	1.63	3

Daily gage height, in feet, of Teton River near Choteau, Mont., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.6					
2		1.65		1.55	1.6		
3		1.7	1.8	1.55			
4		1.75					1.75
5		1.95					1.75
6		2.2					
7		2.2				1.6	
8		2.45	1.85			1.6	
9	1.7	2.55		1.5			
10		2.45					
11		2.45		1.6			
12	1.7	2.6					
13	1.65	2.7				1.63	
14	1.65						
15	1.6		1.5	1.55			
16	1.65	2.1					
17	1.7	2.1					
18	1.7	2.05					
19	1.7	1.95					
20	1.7	1.9					
21	1.7	1.9				1.7	
22	1.7	1.9	1.45			1.7	
23	1.7	1.9					
24	1.65	1.9					
25	1.65	1.85					
26	1.65	1.85		1.5			
27	1.65			1.5	1.6		
28	1.7	1.9	1.5				
29	1.7					1.7	
30	1.7						
31	1.7						

MILK RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Milk River rises in the undulating foothills of the Rocky Mountains in northwestern Montana, near the boundary line between the United States and Canada. Its headwaters flow northeastward into Canada, and for about 100 miles its course is eastward, parallel with

the international boundary; it then turns to the southeast, passes across the northern part of Montana, and empties into the Missouri.

The valley through which Milk River flows is broad and contains many thousand acres of irrigable land. The summer flow of the stream is not sufficient for the irrigation of any considerable part of this area, and it has been proposed to augment the supply by turning into the headwaters of Milk River the abundant waters of the St. Mary basin, which lies immediately adjacent to the sources of the Milk.

Information in regard to the basin is contained in the Annual Reports of the Reclamation Service and in the following publications of the United States Geological Survey (Ann= Annual Report; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 286-287; 21, iv, p 188; 22, iv, pp 271-273; 22, iv, pp 287-288.
Irrigation surveys: Ann 13, iii, pp 62-63.
See page measurements: WS 130, pp 102-103.

SOUTH FORK OF MILK RIVER NEAR BROWNING, MONT.

This station was established April 28, 1905. It is located at Croff's ranch, about 40 miles northeast of Browning, Mont.

The channel is straight for about 100 yards above and below the station. Both banks are composed of gravel, and the right bank is liable to overflow at extreme high water. The bed of the stream is made up of rocks from 6 to 18 inches in diameter, is free from vegetation, and is fairly permanent. There is but one channel at all stages. The current is sluggish at the wading section and swift about 200 feet above. The depth at ordinary stages is about 2 feet.

High-water discharge measurements are made by means of a cable, car, and tagged wire about 200 feet above the gage. The initial point for soundings is the first marker on the tagged wire at the left bank. Low-water measurements are made by wading between the gage and the cable.

The gage, which was observed twice daily by R. J. Croff, was originally a temporary rod installed on the left bank 200 yards from the observer's house. This was replaced May 8, 1905, by a standard chain gage, located at the same place and fastened to supports in the left bank. The length of the chain is 13.66 feet. The gage is referred to bench marks as follows: (1) A stake driven into the bank above the gage; elevation, 8.00 feet. (2) A nail driven into the southeast corner of the log hen house belowing to Mr. Croff; elevation, 12.80 feet. Elevations are above the datum of the gage.

Discharge measurements of South Fork of Milk River near Browning, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28	Stockman and Morse	45	55	0.93	3.60	51
May 28	H. M. Morse	46	54	.78	3.52	42
July 21	do	14	7	1.35	3.13	10
August 30	C. C. Babb				2.80	[a] 2

[a] Estimated.

Daily gage height, in feet, of South Fork of Milk River near Browning, Mont., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	3.5	3.4	3.55	3.4	2.85	3.15
2	.....	3.5	3.4	3.55	3.4	2.85	3.15
3	.....	3.5	3.5	3.6	3.4	2.8	3.15
4	.....	3.5	3.5	3.6	3.3	2.8	3.15
5	.....	3.5	3.4	3.5	3.25	3.0	3.2
6	.....	3.5	3.5	3.5	3.2	3.0	3.2
7	.....	3.5	3.5	3.4	3.2	3.0	3.25
8	.....	3.4	3.55	3.4	3.1	3.0	3.28
9	.....	3.5	3.5	3.35	3.1	2.9	3.32
10	.....	3.7	3.5	3.35	3.1	2.95	3.3
11	.....	3.7	3.5	3.3	3.1	3.0	3.28
12	.....	3.7	3.5	3.2	3.0	2.98	3.25
13	.....	3.7	3.4	3.2	3.0	3.0	3.2
14	.....	3.75	3.4	3.2	3.0	3.0	3.25
15	.....	3.7	3.4	3.2	3.0	2.9	3.3
16	.....	3.65	3.5	3.2	3.0	2.9	3.32
17	.....	3.6	3.5	3.2	3.0	2.9	3.32
18	.....	3.6	3.5	3.2	2.95	2.9	.....
19	.....	3.6	3.45	3.2	2.9	2.9	.....
20	.....	3.6	3.6	3.15	2.9	2.9	.....
21	.....	3.75	3.6	3.1	2.85	2.9	.....
22	.....	3.8	3.6	3.1	2.8	2.8	.....
23	.....	3.75	3.6	3.1	2.8	2.8	.....
24	.....	3.65	3.6	3.1	2.8	2.8	.....
25	.....	3.6	3.65	3.1	2.8	2.8	.....
26	.....	3.55	4.0	3.2	2.8	2.8	.....
27	.....	3.5	4.2	3.3	2.8	2.82	.....
28	3.6	3.5	3.85	3.3	2.8	3.0	.....
29	3.55	3.5	3.75	3.4	2.8	3.08	.....
30	3.5	3.45	3.55	3.45	2.8	3.1	.....
31	.....	3.5	.....	3.4	2.82	.....	.....

NOTE.—Creek frozen over October 18.

Estimated monthly discharge of South Fork of Milk River near Browning, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	78	30	51	3,117
June	144	30	49	2,916
July	51	9	24	1,445
August	30	2	8.5	523
September	9	2	4.4	262
October 1-17	23	12	17	587
The period	.....	.....	.....	8,850

NOTE.—These estimates are only a rough approximation.

MILK RIVER AT HAVRE, MONT.

This station was established May 15, 1898. It is located at the highway bridge at Havre, Mont.

The channel is straight below the station and for a short distance above, when a sharp curve occurs. Both banks are high, being above ordinary floods, and are slightly wooded. The bed of the stream is liable to change with every freshet. The current is sluggish at ordinary stages.

Discharge measurements were originally made by means of a cable stretched across the river not far from the highway bridge. November 4, 1902, the cable was taken out, and discharge measurements have since been made from the downstream side of the bridge to which the gage is attached. The bridge makes an angle of 20° with the normal to the current at the measuring section. The initial point for soundings is marked on the downstream guard rail at the right bank.

The gage is read daily by L. H. Lang, the United States Weather Bureau observer at Havre. January 12, 1904, the old wire gage was replaced by a standard chain gage, which was made to read the same as the old gage, and was located on the downstream side of the bridge. The length of the chain is 25.21 feet. The gage pulley is located at a point which corresponds to a reading of 2.0 feet on the scale. The gage is referred to bench marks as follows: (1) The top of the highest bolt securing the bedplate to cement on top of the southwest pier of the bridge; elevation, 2,486.51 feet above datum. (2) A 20-penny nail in a cottonwood tree 100 feet southwest of the southwest pier of the bridge; elevation, 2,477.44 feet above datum. (3) A standard United States Geological Survey tablet in the stone pier of a column supporting the Great Northern Railway water tank, one-half mile southeast of the gage and near the roundhouse; elevation, 2,482.46 feet. The elevation of the zero of the gage is 2,461.25 feet above datum. The datum used in the establishment of the bench marks is that of the city of Havre, deduced from a temporary bench mark of the United States Geological Survey, which has since been destroyed.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, p 245; WS 27, pp 68-69; 37, p 209; 49, p 267; 66, pp 15-16; 84, p 28; 99, pp 108-109; 130, pp 95-96.
Discharge: WS 27, p 75; 37, p 209; 49, p 267; 66, p 16; 84, p 29; 99, pp 109-110; 130, p 96.
Discharge, monthly: Ann 20, iv, p 245; 21, iv, p 189; 22, iv, p 288; WS 75, p 122; 84, p 31; 99, p 111; 130, p 98.
Discharge, yearly: Ann 20, iv, p 53.
Gage heights: WS 27, p 72; 37, p 210; 49, p 267; 66, p 16; 84, p. 30; 99, p 110; 130, pp 96-97.
Hydrographs: Ann 20, iv, p 246; 21, iv, p 189; 22, iv, p 288.
Rating tables: WS 27, p 76; 39, p 447; 52, p 516; 66, p. 170; 84, pp 30-31; 99, p 111; 130, p 97.

Discharge measurements of Milk River at Havre, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 7	L. R. Stockman	74	45	1.09	3.30	49
May 2	H. M. Morse	86	67	1.27	3.85	85
May 6	do	85	58	1.22	3.59	71
June 5	do	77	43	1.04	3.44	45
July 11 [a]	W. B. Freeman	39	22	.76	3.15	17
July 31	H. M. Morse	82	83	1.36	3.85	113
August 1	do	75	71	.78	3.68	55

[a] Made by wading.

Daily gage height, in feet, of Milk River at Havre, Mont., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	.....	4.4	3.4	3.8	3.55	3.65	3.7
2	.....	4.4	3.5	3.7	3.55	3.45	3.7
3	.....	4.4	3.4	3.6	3.45	3.45	3.6
4	.....	4.35	3.4	3.6	3.45	3.45	3.6
5	.....	4.4	3.4	3.6	3.45	3.35	3.6
6	.....	4.4	3.4	3.6	3.45	3.55	3.6
7	.....	4.3	3.4	3.6	3.45	3.55	3.4
8	.....	4.6	3.3	3.6	3.25	3.55	3.4
9	.....	4.5	3.3	3.5	3.25	3.45	3.4
10	.....	4.3	3.3	3.5	3.25	3.45	3.2
11	.....	4.3	3.2	3.5	3.25	3.25	3.0
12	.....	3.7	3.3	3.6	3.25	3.15	3.0
13	.....	3.6	3.3	3.6	3.25	3.15	3.0
14	.....	3.6	3.3	3.5	3.25	3.25	2.8
15	.....	3.9	3.4	3.5	3.25	3.25	2.7
16	.....	4.0	3.3	3.45	3.15	3.15	2.7
17	.....	4.0	3.4	3.45	3.25	3.05	2.7
18	.....	3.95	3.4	3.35	3.25	2.95	2.6
19	.....	3.9	3.5	3.45	3.25	2.95	2.4
20	.....	4.2	3.4	3.45	3.25	2.95	2.4
21	.....	4.0	3.5	3.35	3.25	2.8	2.4
22	.....	4.0	3.5	3.35	3.15	2.8	2.4
23	.....	3.9	3.5	3.75	3.15	2.7	2.4
24	.....	3.9	3.5	3.65	3.15	2.7	2.3
25	.....	3.8	3.5	3.65	3.05	2.6	2.3
26	3.5	3.8	3.5	3.55	3.25	2.8	2.3
27	4.7	3.6	3.5	3.55	3.35	2.9	.....
28	4.7	3.7	3.6	3.55	3.55	4.9	.....
29	.....	3.6	3.7	3.45	3.65	5.0	.....
30	.....	3.5	3.8	3.45	3.75	4.1	.....
31	.....	3.4	.....	3.45	.....	3.9	.....

NOTE.—River frozen solid to bottom January 15 to February 26; in the first part of March water was flowing over the ice, which was frozen to the bottom.

Station rating table for Milk River at Havre, Mont., from January 1 to May 5, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	46	3.40	55	3.60	73	3.80	102
3.30	50	3.50	63	3.70	85		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during the first part of 1905, and is not well defined.

Station rating table for Milk River at Havre, Mont., from May 6, to August 26, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.80	2	3.40	42	4.00	139	4.60	266
2.90	4	3.50	55	4.10	158	4.70	290
3.00	7	3.60	69	4.20	178	4.80	315
3.10	12	3.70	85	1.30	199	4.90	340
3.20	20	3.80	102	4.40	221	5.00	366
3.30	30	3.90	120	4.50	243	5.10	392

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during the latter part of 1905, and is not well defined.

Estimated monthly discharge of Milk River at Havre, Mont., for 1905.

[Drainage area, 7,300 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January			[a] 5	307	0.00068	0.00078
February			[a] 5	278	.00068	.00071
March			[a] 40	2,460	.0055	.0063
April	102	46	59	3,511	.0081	.0090
May	102	36	62	3,812	.0085	.0098
June	94	10	35	2,083	.0048	.0054
July	366	0	54	3,320	.0074	.0085
August	102	0	25	1,290	.0034	.0033
The period				17,060		

[a] Estimated by C. C. Babb.

MILK RIVER AT MALTA, MONT.

This station was established July 31, 1902. It is located at the highway bridge on the main road one-fourth mile east of the railroad station at Malta, Mont.

The channel is straight for 700 feet above and 250 feet below the station. Both banks are high and sandy and not subject to overflow. The bed of the stream is composed of sand and gravel and shifts considerably during floods. All of the water passes between the two abutments of the bridge at all stages, and the velocity of the current is moderate.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings, marked zero, is a spike on the downstream guard rail at the right bank.

The gage is read once each day by S. C. Loyd. The original wire gage has been replaced by a standard chain gage having the same datum as the old one, fastened to the lower downstream guard rail of the bridge. The length of the chain is 28.61 feet. The bench mark is marked in paint "B.M.U.S.G.S." on the east end of a plank spiked to the south abutment; elevation above gage datum, 13.66 feet. The elevation of the gage datum above sea level is 2,241.4 feet. The datum bench mark is the United States Geological Survey tablet at the Malta schoolhouse and is 37.80 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, pp 26-27; 99, p 103; 130, pp 98-99.
Discharge: 84, p 27; 99, p 104; 130, p 99.
Discharge, monthly: 84, p 28; 99, p 106; 130, p 102.
Gage heights: 84, p 27; 99, pp 104-105; 130, p 100.
Rating tables: 84, p 28; 99, p 105; 130, p 101.

Discharge measurements of Milk River at Malta, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 11	H. M. Morse	20	8.9	0.52	0.73	4.6
June 28	C. T. Prall	69	56	.94	1.25	52
July 24	W. B. Freeman	.....	.....	.....	.80	[a] 5.0
July 29	do	22	28	1.45	1.19	40
August 26	do	9	2.6	.88	.72	2.0
August 26	do	9	2.4	.78	.71	2.0

[a] Estimated.

Daily gage height, in feet, of Milk River at Malta, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.1	1.1	2.2	1.1	0.6	1.0	1.95	2.95	0.55
2	1.1	1.1	2.2	1.1	.6	.9	1.45	2.75	.55
3	1.1	1.1	2.4	1.1	.6	.8	1.05	2.25	([a])
4	1.1	1.1	2.4	1.0	.6	.9	.95	1.95	.....
5	1.1	1.1	2.6	1.1	.6	.9	.95	1.95	.....
6	1.1	1.1	2.8	1.1	.6	.9	.95	1.75	.....
7	1.1	1.1	2.5	1.0	.6	.9	.85	1.55	.....
8	1.1	1.1	2.3	.9	.6	.9	.85	1.35	.....
9	1.1	1.1	2.1	.9	.7	1.0	1.05	1.45	.....
10	1.1	1.1	2.5	.8	.7	1.1	1.65	1.45	.....
11	1.1	1.1	2.0	.8	.7	1.1	1.45	1.45	.....
12	1.1	1.1	2.1	.7	.7	1.1	1.15	1.25	.....
13	1.1	1.1	2.0	.7	.7	1.1	1.65	1.25	.....
14	1.1	1.1	2.0	.7	.7	1.0	1.45	1.15	.....
15	1.1	1.1	2.0	.7	.7	1.0	1.15	1.15	.....
16	1.1	1.1	1.9	.7	.7	1.0	1.05	1.15	.....
17	1.1	1.1	1.9	.7	.7	1.0	1.05	1.05	.....
18	1.1	1.1	2.0	.7	.7	1.0	1.05	1.05	.....
19	1.1	1.1	2.1	.7	.7	1.0	1.05	1.05	.....
20	1.1	1.1	1.8	.7	.7	1.0	1.05	.75	.....
21	1.1	1.1	1.8	.7	.7	1.0	.95	.75	.....
22	1.1	1.1	1.8	.7	.7	1.0	.95	.75	.....
23	1.1	1.2	1.8	.7	.7	1.0	.95	.75	.....
24	1.1	1.3	1.7	.6	.8	1.0	.85	.65	.....
25	1.1	1.3	1.7	.6	.8	.9	.85	.65	.....
26	1.1	1.2	1.5	.6	.8	.8	.85	.65	.....
27	1.1	1.7	1.4	.6	.9	1.0	1.05	.65	.....
28	1.1	1.7	1.4	.6	1.0	1.3	1.05	.65	.....
29	.....	.....	1.3	.6	1.0	1.3	1.25	.65	.....
30	.....	.....	1.3	.6	1.0	1.9	1.15	.55	.....
31	.....	.....	1.1	.....	1.0	.....	3.05	.55	.....

[a] River dry remainder of year.

NOTE.—Ice conditions January 1 to March 3.

Station rating table for Milk River at Malta, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	1	1.40	74	2.10	294	2.80	618
.80	6	1.50	96	2.20	336	2.90	670
.90	12	1.60	122	2.30	380	3.00	722
1.00	19	1.70	151	2.40	424	3.10	778
1.10	29	1.80	183	2.50	472		
1.20	41	1.90	217	2.60	520		
1.30	56	2.00	254	2.70	568		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined throughout; above 2 feet the curve is the same as for 1904.

Estimated monthly discharge of Milk River at Malta, Mont., for 1905.

[Drainage area, 14,040 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	.....	.....	[a] 5	307	0.00036	0.00042
February	.....	.....	[a] 5	278	.00036	.00037
March	618	29	258	15,860	.018	.021
April	29	0	8	476	.00057	.00064
May	19	0	34	2,091	.0024	.0028
June	217	6	27	1,607	.0019	.0021
July	750	9	65	2,828	.0046	.0053
August	696	.....	97	5,964	.0069	.0080
The period	.....	.....	.....	29,410	.....	.....

[a] Estimated by C. C. Babb.

NORTH FORK OF MILK RIVER NEAR CHINOOK, MONT.

This station was established April 22, 1905. It is located at Snedecor's ranch, about 4½ miles north of Chinook, Mont.

The channel is straight for 100 yards above and below the station. The banks are composed of sandy soil, covered with brush and cottonwood trees; they are high and do not overflow. The right bank has a slope of about 45°, and the left of about 30°. The bed of the stream is of sand, with a little vegetation near the left bank, and probably shifts slightly after the highest floods. There is but one channel at all stages and the current is moderate.

Discharge measurements are made by means of a cable, car, and tagged wire just above the gage or by wading at low water. The initial point for soundings is a nail driven into the end of one of the timbers supporting the cable at the left bank.

The gage, which is read once each day by Mrs. R. B. Snedecor, is an inclined rod, which was erected May 22, 1905, to take the place of the temporary rod gage first established. The new gage is nailed in two sections to posts driven into the left bank. The gage is referred to bench-marks as follows: (1) A spike driven in a post just east of the gage; elevation, 11.26 feet. (2) A 20-penny spike in the root of a 10-inch cottonwood tree 20 feet east of the upper end of the gage; elevation, 13.92 feet. (3) A 20-penny spike driven into the root of a 5-inch cottonwood tree 40 feet northeast of the tree to which the east end of the cable is fastened; elevation, 16.12 feet. Elevations are above the datum of the gage.

Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 22	H. M. Morse	56	37	0.95	1.06	36
June 2	do	32	31	1.13	1.05	35
June 16	Stockman and Prall	55	35	.88	1.00	31
July 3	Babb and Prall	55	45	1.49	1.35	67
July 18[a]	W. B. Freeman	29	19	.49	.73	9.5
August 10[a]	do	25	14	.80	.80	11.1
August 23	C. T. Prall				.55	[b]1.0

[a] Wading. [b] Estimated.

Daily gage height, in feet, of North Fork of Milk River near Chinook, Mont., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.
1		1.28	1.15	1.25	0.92	0.45		0.8
2		1.3	1.05	1.32	1.35	.45		8
3		1.3	1.0	1.35	1.05	.43		.8
4		1.25	1.0	1.32	1.0	.35		.8
5		1.25	1.0	1.25	1.5	.35		.8
6		1.25	1.0	1.18	1.25	.32		.8
7		1.21	1.0	1.25	.98	.3		.8
8		1.2	1.0	1.15	.92	.3		.8
9		1.22	.95	1.1	.82	.25		.85
10		1.25	.9	.98	.8	.25		.93
11		1.2	.9	.9	.78	.25		.95
12		1.18	.9	.92	.75			.93
13		1.15	.9	.95	.72			.85
14		1.1	.95	.95	.65			.85
15		1.1	1.02	.9	.65			.88
16		1.1	1.0	.82	.65			.9
17		1.1	1.0	.78	.65			.9
18		1.1	.98	.75	.65			.95
19		1.1	.95	.75	.65			.95
20		1.1	1.02	.72	.6			.95
21		1.05	1.15	.68	.55			.95
22	1.2	1.08	1.15	.65	.52			.95
23	1.2	1.08	1.05	.65	.5		0.7	.93
24	1.18	1.05	1.05	.65	.55		.7	.9
25	1.15	1.05	1.05	.6	.6		.7	.9
26	1.18	1.05	1.05	2.7	.58		.7	.9
27	1.22	1.05	1.22	1.45	.52		.7	.9
28	1.28	1.05	1.22	1.35	.5		.7	
29	1.28	1.05	1.28	1.0	.5		.7	
30	1.25	1.08	1.3	1.5	.45		.8	
31		1.12		1.05	.45		.8	

NOTE.—September 3 to October 22, no flow. November 28 to December 31, frozen.

Station rating table for North Fork of Milk River near Chinook, Mont., from April 23 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	1	1.10	43	1.70	127	2.30	272
.60	3	1.20	53	1.80	147	2.40	302
.70	8	1.30	65	1.90	172	2.50	332
.80	13	1.40	77	2.00	197	2.60	362
.90	23	1.50	92	2.10	222	2.70	392
1.00	33	1.60	107	2.20	247	2.80	422

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is poorly defined and is a basis for only a rough estimate.

Estimated monthly discharge of North Fork of Milk River near Chinook, Mont., for 1905.

[Drainage area, 1,422 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 22-30	63	48	55	984	0.039	0.013
May	65	38	48	2,933	.034	.039
June	65	23	37	2,208	.026	.029
July	392	3	48	2,927	.033	.038
August	92	1	16	972	.011	.013
September	1	0	0	0	.000	.000
October	13	0	2.6	160	.0018	.0021
November 1-27	28	13	21	1,119	.015	.015
The period				11,300		

BEAVER CREEK NEAR ASHFIELD, MONT.

Beaver Creek rises in the Little Rocky Mountains, flows to the northeast and east, and enters Milk River near Hinsdale, Mont.

The gaging station was established July 5, 1903, at bridge No. 455 of the Great Northern Railway, one-half mile west of Ashfield, Mont. It was abandoned December 31, 1903, because the results were affected by backwater from a dam erected a mile below about a month after the establishment of the station. A new station was established at a point 2½ miles farther upstream and beyond the influence of the dam. It is near the ranch house of R. H. Thomas, about 18 miles from Malta and 3 miles south of Ashfield, Mont., the nearest post-office.

The channel is straight for 100 yards above and below the cable. Both banks are high and covered with willows. The left bank is steep and the right is sloping. The bottom of the stream is of mud. There is but one channel at all stages and the flow is very sluggish, the velocity being comparatively low even in the highest floods. The stream carries little water except at the time of spring floods or heavy rains, and during the summer the channel is overgrown with weeds and willows, which have to be cleared out occasionally.

Discharge measurements are made from a cable about 225 feet above the gage. The cable has a span of 100 feet between supports, and a tagged wire marked at 5-foot intervals is stretched above. The initial point for soundings is a nail in the cable support at the left bank.

The gage, which is read daily by Mr. Thomas, is an inclined plank on the right bank, securely fastened to posts set in the ground at each end, and has a vertical extension, which

gives minus readings at very low water. Early in 1905 the gage was referred to the bench marks and was found to have settled, so that the zero mark on the gage read 0.08 foot too high. It has not been corrected. The gage was also found to read 0.01 foot too great per foot vertical. The gage is referred to bench marks as follows: (1) A nail driven flush in the top of a 2 by 4-inch stake, 12 feet south of the gage; elevation, 11.43 feet above gage datum. (2) The top of a railroad spike driven in the northwest corner of Mr. Thomas's house, 1 foot above ground; elevation, 13.35 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 100; 130, pp 108-109.
Discharge: 99, p 100; 130, p. 109.
Discharge, monthly, 130, p 111.
Gage heights: 99, p 101; 130, p 110.
Rating table: 130, p 110.

Discharge measurements of Beaver Creek near Ashfield, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 28	C. T. Prall	53	169	1.00	4.55	169
July 29	W. B. Freeman	7	5	1.42	.17	7
July 30	do	20	39	1.16	1.78	46
July 30	do	20	36	1.15	1.69	42
July 30	do	20	41	1.20	1.86	49

Daily gage height, in feet, of Beaver Creek near Ashfield, Mont., for 1905.

Day.	Mar.	June.	July.	Aug.	Day.	Mar.	June.	July.	Aug.
1			2.70	2.9	17	0.6	1.7	0.6	
2			2.1	1.15	18	.5	1.5	.4	
3			1.7	1.15	19	.5	1.3	.3	
4			1.3	.95	20	.4	1.1	.2	
5			1.0	1.7	21	.2	1.0	.1	
6			.9	1.55	22	.1	.8	.0	
7			.7	.9	23	.05	.8	.0	
8			.5	.3	24	—.1	1.1	.0	
9			.3	.2	25	—.2	2.0	.2	
10			.2	.1	26	—.2	2.5	1.5	
11			.2	.0	27	—.2	2.3	1.8	
12	2.0	0.8	.6	.0	28	—.25	4.6	1.9	
13	1.3	1.2	1.0	.1	29		4.0	.4	
14	1.15	1.2	1.1	.1	30		4.3	1.92	
15	.9	1.4	1.0	.15	31			3.1	
16	.7	1.8	.8	.2					

NOTE.—Creek dry for missing days.

Station rating table for Beaver Creek near Ashfield, Mont., from March 12 to August 16, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	4	1.00	22	2.00	54	3.00	94
0.10	5	1.10	25	2.10	58	3.20	102
0.20	6	1.20	28	2.20	62	3.40	110
0.30	7	1.30	31	2.30	66	3.60	120
0.40	9	1.40	34	2.40	70	3.80	130
0.50	11	1.50	37	2.50	74	4.00	140
0.60	13	1.60	40	2.60	78	4.20	150
0.70	15	1.70	43	2.70	82	4.40	160
0.80	17	1.80	46	2.80	86	4.60	170
0.90	19	1.90	50	2.90	90		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is fairly well defined between gage heights 0 and 2 feet, and has been extended beyond these limits, being based on one measurement at 4.55 feet.

Estimated monthly discharge of Beaver Creek near Ashfield, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	54	0	7.2	428
June	170	0	34.3	2,041
July	98	4	24.1	1,482
August	90	0	10.0	615
The period				4,566

BEAVER CREEK OVERFLOW NEAR BOWDOIN, MONT.

This station was established June 29, 1903. It is located on an overflow channel of Beaver Creek, about 4 miles southeast of the Great Northern Railway section house at Bowdoin, Mont., and is best reached by team from Malta, Mont., 14 miles distant. The water supply is derived partly from the natural drainage of irrigated lands and partly from water wasted over the spillway at a dam on Beaver Creek above.

The channel is straight for 200 feet above and 100 feet below the station. During extreme floods both banks are submerged and the whole valley is covered with water. The bed of the stream at the station forms a small bar, covered with weeds and swamp grass. The current is sluggish, and measurements are affected by a check which is frequently erected at the gates of a lateral about 1 mile below.

Discharge measurements are made by means of a cable, car, and tagged wire, and also by wading. The initial point for soundings is the east side of a post on the west or left bank.

The gage is read daily by John Turmell, who lives about 300 yards distant. It is a vertical board nailed to a cottonwood tree on the right bank about 100 feet above the cable. All the old bench marks have been destroyed, but the zero of the gage is at an elevation of 2,207.84 feet above sea level, as determined from the datum bench mark at the Malta school house. This is based on the elevation of the rail in front of the Great Northern Railway station at Malta, Mont. September 15, 1905, two new bench marks were established from the gage on the assumption that the readings were at that time correct. These bench marks are as follows: (3) The head of a railroad spike driven vertically in a projecting log at the southwest corner of Mr. Turmell's house, 800 feet southwest of the gage; elevation, 21.44 feet above gage zero. (4) The head of a 20-penny spike driven horizontally in the northwest corner of Mr. Turmell's house, 2 feet above the ground; elevation, 19.48 feet above gage zero.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 101-102; 130, p 111.
Discharge: 99, p 102; 130, p 112.
Discharge, daily: 130, p 112.
Discharge, monthly: 130, p 113.
Gage heights: 99, pp 102-103; 130, p 112.

Discharge measurements of Beaver Creek overflow near Bowdoin, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 28	C. T. Prall	89	215	0.55	6.4	118
July 30 [a]	W. B. Freeman	56	77	.2	4.8	15

[a] Float measurement.

Daily gage heights, in feet, and discharge, in second-feet, of Beaver Creek overflow near Bowdoin, Mont., for 1905.

Day.	March.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1					4.8	16	4.4	7
2					4.9	19	4.2	5
3	5.4	43			4.8	16	4.1	4
4	5.3	37			4.7	13	4.0	3
5	5.15	29			4.6	11	3.9	2
6	4.85	18	6.65	138	4.4	7	3.8	2
7	4.85	18	5.0	23	4.3	6	3.7	2
8	4.05	4	4.4	7	4.1	4	3.6	1
9			4.3	6	4.0	3		
10			4.3	6	4.0	3		
11			5.3	37	3.9	2		
12			5.0	23	3.8	2		
13			6.7	143	3.8	2		
14			5.0	23	3.7	2		
15			4.9	19	3.7	2		
16			4.7	13	3.6	1		
17			4.6	11	3.6	1		
18			4.5	9				
19			4.4	7				
20			4.3	6				
21			4.2	5				
22			4.1	4				
23			4.1	4				
24	3.9	2	4.0	3				
25	3.8	2	4.0	3				
26	3.7	2	6.0	83				
27	3.6	1	5.7	61				
28			6.4	116				
29			5.5	49	5.2	31		
30			5.0	23	4.8	16		
31					4.6	11		

NOTE.—No flow on missing days.

Estimated monthly discharge of Beaver Creek overflow near Bowdoin, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum	Minimum.	Mean.	
March 3-8, 24-27	43	1	16	309
June 6-30	138	3	33	1,631
July 1-17, 29-31	31	1	8	333
August 1-8	7	1	3	51
The period				2,324

PRIVATE CANALS IN MILK RIVER VALLEY.

DESCRIPTION OF CANALS.

During 1905 a number of stations were maintained on private canals in Milk River Valley, mainly for the purpose of ascertaining the extent of the private water rights. With one exception—the Rock Creek canal near Hinsdale, in Valley County—these canals are located in Choteau County and are used for the irrigation of lands in the vicinity of Harlem and Chinook.

The canals are all built on small grades and in soil which is easily eroded. In many of them deposition of silt has taken place, and in nearly all there is a growth of weeds and moss. At low stages the water is uniformly sluggish. In order to divert water into the laterals checks are erected in the main channels, and these checks often produce backwater effects for long distances above. They were put up under a great variety of conditions, and as a result many different velocities are found to exist at the same gage height during the season; in order to establish the correct relation between gage height and discharge it has been found necessary to make several rating curves for the same canal station. All the canals except the Rock Creek canal at Hinsdale and the Cook canal at Chinook have more than one station rating curve.

In July, 1905, an injunction suit was brought by the United States Office of Indian Affairs against later appropriators of water on Milk River and its tributaries above, to determine the rights pertaining to the agency ditch which supplies the Fort Belknap Indian Reservation. For that reason the water was shut off from some of the ditches, including the Matheson and Cook canals, during part of the irrigation season.

The gaging stations maintained were as follows:

Paradise Valley canal near Chinook, Mont.
Cook canal near Chinook, Mont.
Matheson canal near Chinook, Mont.
Harlem canal near Zurich, Mont.
Agency ditch near Harlem, Mont.
Fort Belknap canal near Chinook, Mont.

In addition to the canal stations regularly maintained, temporary gaging stations were established on Reser and West Fork ditches, taken from West Fork of Milk River, and miscellaneous information was collected in regard to the Dowen & Buckley, Rokita, and Corregan ditches from North Fork of Milk River; the Winter-Anderson canal from Milk River; and ditches from Parallel Creek. The water rights pertaining to these canals are to be adjudicated in the general lawsuit recently instituted.

PARADISE VALLEY CANAL NEAR CHINOOK, MONT.

This canal is used for the irrigation of bottom lands several miles east of Chinook, Mont. It diverts water from the south side of Milk River about 7 miles below Chinook, and its general course is easterly.

The station was established in June, 1903. It is reached by driving along the south river road from Chinook, Mont.

The channel is straight and the section at the station is semicircular. The bed of the canal is composed of mud and sand and the banks are covered with brush and weeds.

Discharge measurements are made from a footbridge. The initial point for soundings is the zero on the bridge at the left bank.

The gage was read once each day during the irrigation season of 1905 by Rudolph Friede, who lives 300 yards distant. It is a vertical board driven into the bed of the canal about 500 feet below the head gates and just at the footbridge from which the discharge measurements are made. The gage is referred to bench marks as follows: (1) A spike driven in the top of a 6 by 6 inch post on the left side of the downstream end of the head gates; elevation, 7.29 feet. (2) A spike in the southwest side of a 12-inch post 40 feet south of the south end of the dam and 28 paces east of bench mark No. 1; elevation, 7.38 feet. Elevations are above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 107; 130, p 105.
Discharge: 99, p 107; 130, p 105.
Discharge, daily: 130, p 106.
Discharge, monthly: 130, p 106.
Gage heights: 99, p 107.

Discharge measurements of Paradise Valley canal near Chinook, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 8	L. R. Stockman	11	5.0	0.70	0.45	3.5
April 24	Stockman and Morse	20	11.5	.87	.76	10.1
May 17	H. M. Morse	18	9.3	.71	.81	6.6
June 3	do	20	14.6	.54	1.08	7.8
June 17	Stockman and Prall	18	11.0	.43	.98	4.8
June 24	C. T. Prall	18	11.3	.48	1.01	5.4
June 24	do	18	13.0	.39	1.02	5.0
July 8	Freeman and Morse	18	12.5	.38	1.09	4.8
July 15	C. T. Prall	17	11.0	.31	.98	3.4
July 21	W. B. Freeman	18	11.6	.44	1.01	5.1
July 27	H. M. Morse	19	20.0	.53	1.37	10.0
August 5	W. B. Freeman	9	2.6	.26	.50	.7

Daily gage height, in feet, and discharge, in second feet, of Paradise Valley canal near Chinook Mont., for 1905.

Day.	March.		April.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	.....	.....	0.17	1	0.47	4	1.14	8	1.24	8	0.57	1.0
2	.....	.....	.15	.5	.56	6	1.17	8	1.30	9	.50	.5
3	.....	.....	.15	.5	.67	8	1.12	8	1.21	7	.49	.5
4	.....	.....	.40	3	.78	10	1.05	7	1.21	7	.44	.5
5	.....	.....	.46	4	.92	13	1.11	8	1.20	7	.50	.5
6	.....	.....	.47	4	1.17	19	1.15	10	1.19	7	.48	.5
7	.....	.....	.47	4	1.09	17	1.20	11	1.22	7	.45	.5
8	.....	.....	.42	3	1.08	17	1.50	16	.92	4	.45	.5
9	.....	.....	.42	3	1.11	17	1.20	11	1.54	15	.44	.5
10	.....	.....	.54	5	1.08	17	1.03	6	1.14	6	.43	.5
11	.....	.....	.75	10	1.13	18	1.08	8	.68	2	.41	.5
12	.....	.....	1.08	17	1.09	17	1.11	8	.89	3	.40	.3
13	.....	.....	1.10	17	1.10	17	1.19	11	.90	3	.39	.3
14	.....	.....	1.02	15	1.17	19	1.04	7	.95	4	.35	.2
15	.....	.....	.98	15	.84	7	1.07	7	.97	4	.30	.2
16	.....	.....	.92	13	.81	6.5	1.02	6	1.10	6	.20	.1
17	.....	.....	.86	12	.78	6.5	.98	5	1.13	6	.10	.....
18	.....	.....	1.08	17	.82	6.5	.98	5	1.13	6	.....	.....
19	.....	.....	1.08	17	.80	6.5	.96	4	1.05	5	.....	.....
20	.....	.....	1.11	17	.80	6.5	1.01	5	1.06	5	.....	.....
21	.....	.....	1.01	15	.80	6.5	.96	4	1.05	5	.....	.....
22	.....	.....	.84	12	.82	6.5	.94	4	.94	4	.....	.....
23	.....	.....	.83	11	.90	7	.94	4	.81	3	.....	.....
24	.....	.....	.78	10	1.12	8	1.00	5	.73	2	.....	.....
25	.....	.....	.71	9	1.09	8	1.09	6	.66	2	.....	.....
26	0.21	1	.64	8	1.11	8	1.09	6	.65	2	.....	.....
27	.23	1	.49	4	1.07	8	1.15	6	1.60	17	.....	.....
28	.42	3	.48	4	1.10	8	1.36	10	1.40	11	.....	.....
29	.48	4	.45	4	1.09	8	1.22	7	1.33	9	.....	.....
30	.30	2	.41	3	1.10	8	1.25	8	.85	3	.....	.....
31	.24	1	.....	.....	1.11	8	.....	.....	.69	2	.....	.....

Estimated monthly discharge of Paradise Valley canal near Chinook, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 26-31	4	1	2	24
April	17	.5	9	536
May	19	4	10	615
June	16	4	7	417
July	17	2	6	369
August	1	.1	.4	13
The period	.....	.....	.....	1,974

COOK CANAL NEAR CHINOOK, MONT.

This canal diverts water from North Fork of Milk River, one of the most constant tributaries of that stream. The head-gates are situated about 3 miles east of Chinook, Mont., and the course of the canal is nearly due south for about 2 miles, beyond which it turns to the east and crosses to the south side of the river, where the greater part of the lands irrigated by the canal are situated.

The station was established April 10, 1905. It is located at a small wooden highway bridge on the road running parallel to the Great Northern Railway about 3 miles east of Chinook.

The channel is straight for 25 feet above and 300 feet below the station, there being a right-angled turn directly above the bridge. The banks are of earth fill and are above the level of the surrounding lands. The bed of the stream is composed of soft mud covered with vegetation, and is permanent. The water has a depth of about 3 feet at ordinary stages and the velocity is low.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is a paint mark on the floor of the bridge, directly over the right abutment on the downstream side.

The gage, which was read once each day during the irrigation season of 1905 by George W. Hartman, is a vertical rod driven into the bed of the canal near the left bank about one-fourth mile above the bridge. The bench mark is a spike in the west side of a post in the fence just east of the canal; elevation, 4.61 feet above the datum of the gage.

Discharge measurements of Cook canal near Chinook, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
April 10	L. R. Stockman	14	32.8	1.15	3.4	37.7
April 24	Stockman and Morse	13	30.4	1.16	3.28	35.5
May 17	H. M. Morse	13	29.0	.92	3.18	26.7
June 3	do	14	28.2	.72	3.02	20.6
June 17	Stockman and Prall	14	27.0	.80	2.98	21.5
June 24	C. T. Prall	14	30.2	1.01	3.26	30.6
July 3	Babb and Prall	14	17.3	.17	2.39	3.0
July 7	W B. Freeman	14	17.9	.13	2.22	2.3
July 15	C. T. Prall	14	25.0	.54	2.80	13.4
August 5	W. B. Freeman	14	27.0	.64	2.93	17.0
August 11	H. M. Morse	14	19.0	.30	2.45	6.0

Daily gage heights, in feet, and discharge, in second-feet, of Cook canal near Chinook, Mont., for 1905.

Day.	April.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	.....	.....	3.7	50	1.9	0	.....	0	2.95	19
2	.....	.....	3.7	50	1.9	0	.....	0	3.0	21
3	.....	.....	3.65	47	3.02	21	2.39	4	2.9	17
4	.....	.....	3.6	45	1.8	0	.....	4	2.4	4
5	.....	.....	.....	0	1.8	0	.....	3	2.93	17
6	.....	.....	.....	0	1.7	0	.....	2	2.3	3
7	.....	.....	.....	0	2.0	0	2.22	2	2.4	4
8	.....	.....	.....	0	3.2	29	2.15	1	2.4	4
9	.....	.....	.....	0	3.1	25	3.1	25	2.4	4
10	3.4	38	.....	0	3.1	25	3.0	21	2.3	3
11	.....	.....	2.75	12	3.1	25	2.9	17	2.45	5
12	.....	.....	2.8	13	3.2	29	2.1	0	2.4	4
13	.....	.....	2.95	19	3.2	29	1.2	0	2.0	0
14	.....	.....	3.0	21	3.1	25	1.3	0	1.75	0
15	.....	.....	3.1	25	3.0	21	2.8	13	1.7	0
16	.....	.....	3.15	27	3.1	25	1.3	0	1.7	0
17	.....	.....	3.2	29	3.0	21	1.3	0	1.5	0
18	.....	.....	3.15	27	3.0	21	1.3	0	1.55	0
19	.....	.....	3.2	29	2.9	17	1.25	0	1.82	0
20	.....	.....	3.1	25	2.9	17	1.2	0	1.4	0
21	.....	.....	3.15	27	2.9	17	1.9	0	1.4	0
22	.....	.....	3.1	25	2.9	17	1.25	0	1.35	0
23	.....	.....	2.6	8	3.0	21	1.2	0	1.35	0
24	3.28	36	2.0	0	3.1	25	1.2	0	1 3	0
25	.....	.....	2.0	0	3.3	33	1.2	0	1.25	0
26	.....	.....	2.0	0	2.9	17	1.3	0	.....	.....
27	.....	.....	2.0	0	2.9	17	2.4	4	.....	.....
28	.....	.....	2.0	0	2.9	17	2.6	8	.....	.....
29	.....	.....	1.95	0	2.2	2	2.8	13	.....	.....
30	.....	.....	1.9	0	.....	0	2.8	13	.....	.....
31	.....	.....	1.9	0	.....	.....	2.7	10	.....	.....

Estimated monthly discharge of Cook canal near Chinook, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	.....	.....	[a] 37.0	2,202
May	50	0	15.5	953
June	33	0	16.5	982
July	25	0	4.5	277
August 1-12	21	0	9.0	214
The period	.....	.....	.....	4,628

[a] Estimated.

MATHESON CANAL NEAR CHINOOK, MONT.

This canal diverts water from the south side of North Fork of Milk River. The head-gates are situated about 3½ miles east of Chinook, Mont., and about three-fourths of a mile below the head of the Cook canal. The general course of the canal is easterly and the irrigated lands under it lie along the Great Northern Railway.

The station was established April 10, 1905. It is located at a footbridge 200 feet below the head-gates.

The channel is straight for 200 feet above and below the station. The canal is in a cut and the banks are high; the right is covered with willows and the left with brush. The bed is composed of sand and is covered with vegetation. The velocity is about 1.4 feet per second when the canal is running full.

Discharge measurements are made from the bridge. The initial point for soundings is at the extreme end of the bridge timbers on the right bank.

The gage, which was read once each day during the irrigation season by H. C. Reynolds, is a vertical rod driven into the bed of the canal immediately below the bridge. The gage is referred to bench marks as follows: (1) A 60-penny nail in the root of a 5-inch willow tree, 180 feet south of the head-gates of the canal; elevation, 9.58 feet above the datum of the gage. (2) A nail in a 3-inch willow tree, 180 feet south of the head of the canal, east of bench mark No. 1 and across the road from it; elevation, 9.34 feet above the datum of the gage.

Discharge measurements of Matheson canal near Chinook, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 10	L. R. Stockman	11.0	18.3	1.42	3.15	25.9
April 24	Stockman and Morse	9.3	8.2	.83	2.1	6.8
May 17	H. M. Morse	7.5	5.0	.58	1.76	2.9
June 3	do	9.5	11.8	.68	2.52	8.0
June 17	Stockman and Prall	10.0	15.2	.60	2.85	9.1
June 23	C. T. Prall	10.0	18.6	.68	3.17	12.7
June 23	do	10.0	17.0	.68	3.05	11.5
July 8	Freeman and Morse		5.6	.13	1.85	.7
July 15	C. T. Prall	9.2	10.0	.42	2.29	4.0
July 21	W. B. Freeman	8.0	4.0	.11	1.76	.5
July 27	H. M. Morse	10.0	13.0	.63	2.72	8.0
August 11	do	8.0	4.8	.24	1.79	1.0
August 19	C. T. Prall				1.45	.25

NOTE.—Grass removed from canal bed after June 23.

Daily gage height, in feet, and discharge, in second-feet, of Matheson canal near Chinook, Mont., for 1905.

Day.	April.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	.....	26	3.25	28	2.8	9	.....	7	1.6	0.5
2	.....	26	2.88	20	2.7	8.5	.....	7	1.55	.4
3	.....	26	3.2	27	2.7	8.5	2.38	5	1.5	.3
4	.....	26	2.88	20	2.7	8.5	2.5	6	1.5	.3
5	.....	26	2.8	18	2.7	8.5	2.0	2	1.5	.3
6	.....	26	2.8	18	2.65	8.5	2.0	2	1.5	.3
7	.....	26	2.7	16	2.65	8.5	1.9	1	1.3	.0
8	.....	26	2.62	15	2.65	8.5	1.8	1	1.2	.0
9	.....	26	2.6	14	2.65	8.5	2.3	4	1.7	.0
10	3.2	27	2.45	12	2.65	8.5	2.85	9	1.8	1.0
11	3.2	27	2.28	9	2.6	8	2.8	9	1.8	1.0
12	3.15	26	2.25	9	2.6	8	2.6	7	1.7	.7
13	3.12	25	.....	7.5	2.6	8	2.5	6	1.65	.5
14	2.95	21	.....	6	2.65	8	2.3	4	1.5	.3
15	2.7	16	.....	5	2.65	8	2.25	4	1.5	.3
16	2.65	15	.....	4	2.6	8	2.45	5	1.5	.3
17	2.6	14	1.76	3	2.85	9	2.4	5	1.7	.7
18	2.58	14	2.1	7	2.6	7	1.8	1	1.7	.7
19	2.55	13	2.22	8	2.5	6	1.8	1	1.6	.5
20	2.55	13	2.72	8.5	2.5	6	1.85	1	1.5	.3
21	2.55	13	2.8	9	2.7	8	1.8	1	1.5	.3
22	2.9	20	2.92	9	2.7	8	2.2	3	1.65	.6
23	3.0	22	2.6	8	3.1	12	1.8	1	.....	.....
24	2.1	7	2.55	8	3.0	11	1.8	1	.....	.....
25	2.0	6	2.62	8	3.0	11	1.8	1	.....	.....
26	2.05	6	2.6	8	2.9	10	2.45	5	.....	.....
27	2.05	6	2.7	8.5	2.8	9	2.72	8	.....	.....
28	2.1	7	2.75	9	2.85	9	1.85	1	.....	.....
29	3.05	23	2.8	9	2.6	7	1.7	1	.....	.....
30	3.18	27	2.8	9	3.0	11	1.6	.5	.....	.....
31	.....	.....	2.8	9	.....	.....	1.6	.5	.....	.....

NOTE.—Discharge April 1-9 estimated.

Estimated monthly discharge of Matheson canal near Chinook, Mont., in 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	27	6.0	19.0	1,131
May	28	3.0	11.0	676
June	12	6.0	9.0	536
July	9	.5	3.5	215
August 1-22	1	0	.4	17
The period	.....	.....	.....	2,575

HARLEM CANAL NEAR ZURICH, MONT.

The Harlem canal is owned by a corporation composed of farmers and is used to irrigate a considerable area of bottom lands near Harlem. It diverts water from the north side of Milk River about 10½ miles below Chinook and flows eastward about 12 miles.

The station was established in June, 1903. It is located about 500 feet below the head-gates of the canal, which are 1½ miles southeast of the Great Northern Railway section house at Zurich and is best reached by driving from Harlem or Chinook.

Discharge measurements are made by wading at the gage. The initial point for soundings is a stake driven into the left bank, near the gage. Flood measurements can be made from a small highway bridge 2 miles below.

The gage was read daily during the irrigation season of 1905 by John Palm, who lives about one-half mile below. It is a vertical board driven into the bed of the canal. The bench-mark is a spike in the downstream face of a 6 by 8 inch post at the left bank, on the downstream side of the head-gate. The spike is 0.8 foot below the top of the cross piece and has an elevation of 11.89 feet above the gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 106; 130, pp 106-107.
Discharge: 99, pp 106, 136; 130, p 107.
Discharge, monthly, 130, p 108.
Gage heights: 130, p 107.
Rating table: 130, p 108.

Discharge measurements of Harlem canal near Zurich, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 8	L. R. Stockman	16	26	0.4	1.35	10.5
April 24	Stockman and Morse	17	27	.54	1.12	15.0
May 17	H. M. Morse	20	36	.52	1.38	19.0
June 3	do	16	24	.81	1.58	19.0
June 17	Stockman and Prall	19	32	.23	.98	7.3
June 24	C. T. Prall	13	10	.25	.68	2.5
July 8	Freeman and Morse	.....	35	.74	2.21	26.0
July 15	C. T. Prall	.....	20	.51	1.35	10.0
July 21	W. B. Freeman	.....	15	.35	1.05	5.3
July 27	H. M. Morse	.....	52	.97	2.96	51.0
August 5	W. B. Freeman	.....	7	.15	.45	[a] 1.2
August 11	H. M. Morse	.....	20	.67	1.37	14.0

[a] Leakage through gates.

Daily gage heights, in feet, and discharge, in second-feet, of Harlem canal near Zurich, Mont., for 1905.

Day.	March.		April.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.93	21	1.0	12	1.6	19	1.4	15	1.35	18
2			1.93	21	.9	10	1.6	19	1.6	19		0
3			1.93	21	.9	10	1.6	19	1.98	22		0
4			1.53	14	.8	8	1.5	17		25		0
5	2.33	28	1.43	12	.8	8	1.3	13	2.3	28	.45	1
6	2.33	28	1.43	12	1.1	14	1.0	8	2.1	24	1.4	15
7	2.43	30	1.33	10		17	.9	6	2.28	28	1.2	11
8	2.43	30	1.33	10	1.5	21	1.1	10	2.41	30	1.2	11
9	2.53	32	1.10	6	1.7	25	1.3	13	2.4	30	1.4	15
10	2.43	30	1.10	6	1.8	27	1.6	19	2.45	31	1.5	17
11	2.33	30	1.65	16	1.8	27	1.4	15	2.12	24	1.35	14
12	2.73	36	2.50	32	1.75	26	1.2	11	1.96	21	1.25	12
13	2.83	38	2.50	32	1.7	25	1.15	10	1.78	18	1.2	11
14	2.63	34	2.50	32	1.6	23	1.3	13	1.5	13	1.1	10
15		0	2.40	30	1.6	23	1.1	10	1.4	11	.95	7
16	2.13	25	2.40	30	1.35	18	1.05	9	1.22	8	.85	5
17		0	2.40	30	1.2	15	.98	7	1.17	7	.8	4
18		0	1.80	27	1.1	14	.9	6	1.1	6	2.0	26
19	2.33	28	1.60	23	1.1	14	.8	4	1.05	5	.85	5
20	2.33	28	1.45	20	.85	9	.78	4	1.05	5		0
21	2.43	30	1.40	19	.75	7	.75	4	1.0	5		
22	2.63	34	1.30	17	.8	8	.74	4	1.0	5		
23	2.33	28	1.20	15	.9	10	.70	3	.98	4		
24	2.33	28	1.10	14	1.0	12	.68	3	.9	3		
25	2.23	27	1.10	14	1.15	14	.68	3	.87	3		
26	2.03	23	1.20	15	1.3	13	.65	2	1.6	15		
27	2.03	23	1.20	15	1.4	15	.65	2	2.83	48		
28	2.03	23	1.10	14		16	.85	5	4.05	73		
29	2.13	25	1.00	12	1.5	17	1.10	10	3.2	56		
30	2.13	25	1.00	12	1.6	19	1.20	13	1.75	26		
31	2.13	25			1.6	19			1.5	21		

Estimated monthly discharge of Harlem canal near Zurich, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 5-31	38	0	25.5	1,366
April	32	6	18	1,071
May	27	7	16	984
June	19	2	9	536
July	73	3	20	1,230
August 1-19	26	0	10	377
The period				5,564

AGENCY DITCH NEAR HARLEM, MONT.

This canal was built by the United States Indian Office and is used for the irrigation of land on the Fort Belknap Indian Reservation. It diverts water from the south side of Milk River, flows southward and eastward for about 11 miles, and has several laterals of considerable size. The head gates are situated near the agency buildings, about 4 miles south of Harlem, Mont.

The station was established July 14, 1905. It is located at the highway bridge about one-fourth of a mile below the head gates.

The channel is straight for 300 feet above and below the station. Both banks are high and have slopes of about 1½ to 1. The bed of the canal is composed of firm earth, comparatively free from vegetation, and is permanent.

Discharge measurements are made from the downstream side of the wooden-truss bridge, which has a span of 45 feet. The initial point for soundings is a nail at the end of the downstream lower chord of the bridge at the right bank.

The gage, which was read gratuitously once each day during the irrigation season by C. M. Zeibach, chief clerk of the agency, is a vertical rod driven into the bed of the canal 15 feet below the bridge and 5 feet from the right bank. The gage is referred to bench marks as follows: (1) The head of a 60-penny spike driven vertically into an 8 by 8 inch timber on the south end and lower side of the bridge; elevation, 12.68 feet above the zero of the gage. (2) The highest point on a large granite bowlder at the north end and lower side of the bridge; elevation above the zero of the gage, 14.51 feet.

Discharge measurements of Agency ditch near Harlem, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 14	Prall and Freeman	20	30	0.81	3.24	24
July 28	W. B. Freeman	24	67	.77	4.82	[a] 52
July 28	do	24	60	1.04	4.53	63
August 4	C. T. Prall	24	54	.55	4.3	[a] 29
August 17	do	22	44	.33	3.8	[a] 14
August 25	do	18	18	1.01	2.5	18
September 5	W. B. Freeman	14	4	.4	1.75	2

[a] Backwater.

Daily gage height, in feet, and discharge, in second feet, of Agency ditch near Harlem, Mont., in 1905.

Day.	July.		August.		September.		Day.	July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1		0	4.4	33	1.9	5	17	3.1	21	3.8	14		
2		0	4.3	29		4	18	2.9	16	3.7	12		
3		0	4.3	29		3	19	2.7	12	3.6	11		
4		0	4.3	29	1.8	3	20	2.6	10	3.5	9		
5		0	4.2	25	1.75	2	21	2.5	8	3.4	8		
6		0	4.2	25		2	22	2.5	8	3.3	8		
7		0	4.2	25		1	23	2.5	8	3.2	7		
8		0	4.2	25		1	24	2.0	2	3.15	6		
9		32	4.2	25		0	25	1.8	1	2.5	18		
10		32	4.2	25		0	26	1.7	1		16		
11		32	4.1	22		0	27	1.6	0		14		
12		32	4.1	22			28	4.8	63		11		
13		29	4.1	22			29	5.2	52		9		
14	3.32	27	4.0	19			30	5.3	52		7		
15	2.9	16	3.95	18			31	4.8	51		5		
16	3.1	21	3.9	16									

Estimated monthly discharge of Agency ditch near Harlem, Mont., in 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 8-31	63	0	23	1,049
August	33	5	18	1,107
September 1-8	5	1	3	48
The period				2,204

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

The Fort Belknap canal is owned by a corporation composed of farmers and is used for the irrigation of extensive areas of bottom lands near Chinook, Mont. It diverts water from the north side of Milk River about 8 miles above Chinook.

The station was established June 21, 1903. It is located at the highway crossing 1 mile below the head gates of the canal and is reached by driving.

The channel is curved above and straight below the station. Both banks are sloping, and the bed is composed of sand and gravel.

Discharge measurements are made from the wooden highway bridge, to which the gage is attached. The initial point for soundings is a spike 15 feet from the gage on the downstream hand rail.

The gage was read daily until August 12, 1905, by D. E. Martin, and from that date to the end of the irrigation season by Morris Jones. The original gage was a vertical board fastened to the downstream chord of the highway bridge. This was replaced July 28, 1905, by a rod gage driven into the bed of the canal just below the bridge, the same datum being used. The gage is referred to bench marks as follows: (1) A nail at the base of a large cottonwood tree 300 feet southeast of the gage; elevation, 3.91 feet above the zero of the gage and 2,427.80 feet above sea level. (2) A nail in a telephone pole 30 feet northeast of the bridge; elevation, 7.57 feet above gage datum and 2,431.46 feet above sea level. This gage datum is 0.15 foot higher than that of 1903.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description; 99, pp 107-108; 130, p 103.
Discharge; 99, p 108; 130, p 104.
Discharge, monthly: 130, p 105.
Gage heights; 99, p. 108; 130, p. 104.
Rating table; 130, p 104.

Discharge measurements of Fort Belknap canal near Chinook, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 10	L. R. Stockman	30.0	51	1.00	2.83	51
April 22	do	33.5	55	1.17	2.92	64
May 19	H. M. Morse	28.0	46	1.01	2.70	46
June 16	Stockman and Prall	27.5	42	.67	2.60	28
July 1	H. M. Morse	36.0	63	1.08	3.18	68
July 12	C. T. Prall	28.0	42	.52	2.57	22
July 20	W. B. Freeman		14	.35	1.50	5
July 28	H. M. Morse		86	1.51	3.62	130
July 29	do		37	1.49	2.35	55
August 3	C. T. Prall		42	1.49	2.68	63
August 3[a]	do		56	1.22	3.00	68
August 8	W. B. Freeman		60	.98	3.16	59
August 15	H. M. Morse		41	.37	2.62	15
August 23	C. T. Prall				.65	[b] 1

[a] Affected by backwater from check in canal. [b] Estimated.

Daily gage heights, in feet, and discharge, in second-feet, of Fort Belknap canal near Chinook, Mont., for 1905.

Day.	March.		April.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			3.25	82	3.1	73	2.7	48	3.18	68	2.5	64
2			3.15	76	3.1	73	2.9	60		55	2.5	64
3			3.05	70	3.0	66	2.9	60	2.8	39	3.0	65
4			3.05	70	3.0	66	2.7	48	2.8	39	3.0	64
5			2.95	63	2.9	60	2.6	46	2.8	39	3.3	63
6			2.95	63	2.9	60	2.7	44	2.9	47	3.3	62
7			2.95	63	3.0	66	2.7	42	3.0	54	3.3	61
8			2.85	57	2.9	60	2.7	40	3.1	62	3.2	59
9			2.95	63	2.9	60	2.7	38	3.0	54	3.1	54
10			3.05	56	2.9	60	2.7	36	2.9	47	3.0	46
11			2.8	54	2.9	60	2.7	34	2.8	39	2.9	38
12			2.9	60	2.9	60	2.7	32	2.7	32	2.8	30
13			2.9	60	2.8	54		31	2.6	24		25
14			2.9	60	2.9	60		30	2.5	20		20
15			3.0	66	2.8	54		29	2.4	18	2.6	15
16			3.0	66	2.8	54	2.6	28		14	2.4	9
17			3.0	66	2.7	48		27		11	2.0	5
18			3.0	66	2.7	48		26		8	1.5	3
19			3.0	66	2.7	48	2.6	25		7	1.1	2
20			3.1	73	2.7	48	2.5	24	1.5	5	1.0	2
21			3.0	66	2.5	36	2.5	23		5	.9	2
22			2.92	64	2.7	48	2.5	22		4	.8	1
23			3.0	66	3.0	66	2.45	21		4	.7	1
24			3.0	66	3.1	73	2.45	20		4	.6	1
25			3.0	66	3.2	79		19		3	.6	1
26			3.0	66	3.1	73		18		3	.6	1
27	3.55	100	3.0	66	3.0	66		17		3	.6	1
28	3.45	94	2.9	60	2.9	60		16	3.62	130	.6	1
29	3.35	88	3.1	73	2.9	60		30	2.35	55	.6	1
30	3.25	82	3.2	79	2.8	54		40	2.6	70	.6	1
31	3.25	82			2.8	54			2.6	70	.6	1

Estimated monthly discharge of Fort Belknap canal near Chinook, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 27-31	100	82	89	883
April	82	54	66	3,927
May	79	36	60	3,689
June	60	16	32	1,904
July	130	3	33	2,029
August	65	1	25	1,537
The period				13,970

RESER DITCH NEAR CHINOOK, MONT.

The Reser ditch diverts water from West Fork of Milk River at a point about 12 miles northwest of Chinook. The original dam and some dikes were constructed in 1900, but were destroyed by floods the same year. The present dam was built in 1904 and the ditch was completed and first used in April, 1905. It is designed to serve about 400 acres of land owned by A. H. and E. T. Reser.

A temporary gaging station was established July 10, 1905. It is located about 1 mile below the head-gates of the ditch.

A gage rod, which was observed by A. H. Reser, who furnished the records gratuitously, was driven into the bottom of the ditch about 10 feet above the measuring section. A bench mark was established on the chipped point of a large granite bowlder 75 feet south of the ditch and 250 feet west of the station; elevation of bench mark above the datum of the gage, 3.82 feet.

The ditch was dry during a considerable part of the irrigation season, and for this reason but two measurements of discharge were secured. It was visited five times between June 21 and August 2 by various employees of the Reclamation Service.

Discharge measurements of Reser ditch near Chinook, Mont., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. ft.	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 10	C. T. Prall	8.6	0.69	2.50	5.9
August 2	W. B. Freeman	8.1	.79	2.53	6.4

Daily gage height, in feet, and discharge in second-feet of Reser ditch near Chinook, Mont., for 1905.

Day.	April.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1				3		3		0	2.6	7
2				3		3		0	2.6	7
3				3		3		0	2.6	7
4				3		3		0	2.6	7
5				3		3		0	2.6	6
6				3		3		0		6
7				3		3		0	2.5	6
8				3		3		0	2.5	6
9		[a] 3		3		3		0	2.5	6
10		3		3		3	2.5	6		0
11		3		3		3		6		0
12		3		3		3	2.5	6		0
13		3		3		3	2.4	5		0
14		3		3		3	2.7	8		0
15		3		3		3	2.4	5		0
16		3		3			2.3	4		0
17		3		3				0		0
18		3		3				0		0
19		3		3				0		0
20		3		3				0		0
21		3		3		0		0		0
22		3		3		0		0		0
23		3		3		0		0		0
24		3		3		0		0		0
25		3		3		0		0		0
26		3		3		0		0		0
27		3		3		0		0		0
28		3		3		0		0		0
29		3		3		0		0		0
30		3		3		0		0		0
31				3		0	2.5	6		0

[a] Estimated April 9–June 15.

Estimated monthly discharge of Reser ditch near Chinook, Mont., in 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 9–30			[a] 3.0	131
May			[a] 3.0	184
June 1–15			[a] 3.0	90
July	8	0	1.5	92
August	7	0	1.9	114
The period	8	0		611

[a] Estimated.

WEST FORK DITCH NEAR CHINOOK, MONT.

The West Fork ditch diverts water from West Fork of Milk River about 4 miles north of Chinook, Mont. In 1898 a dam was constructed at this point and a ditch which irrigated about 75 acres. The ditch was extended in subsequent years and now serves, it is claimed, several hundred acres of land. A new dam was constructed in 1904 near the original location. Several individuals were at first interested in the West Fork ditch, but it is now controlled exclusively by the Empire Cattle Company.

A temporary gaging station was established on this ditch June 16, 1905, about 200 feet below the head-gates.

A gage rod was driven into the bottom of the ditch at the measuring section. It was referred to a bench mark consisting of a 20-penny nail driven vertically into a 6 by 12 inch timber on the lower side of the head-gates at left bank; elevation above the datum of the gage, 5.50 feet.

An injunction was served on the owners of this ditch in the latter part of June and the water was turned off until July 11. Several measurements of discharge were made, the results of which are given below:

Discharge measurements of West Fork ditch near Chinook, Mont., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. ft.	*Ft. per. sec.*	*Feet.*	*Sec.-ft.*
June 16	Prall and Stockman	7	0.84	2.80	5.9
July 11	Prall and Morse	14	.90	3.43	12.6
July 18	W. B. Freeman			1.70	[a] 1
August 2	do	11.5	1.03	3.55	12.0
August 10	do	12.8	1.03	3.50	13.0
August 15	H. M. Morse	6.8	.97	2.90	6.6

[a] Estimated.

Daily gage heights, in feet, and discharge, in second-feet, of West Fork ditch near Chinook, Mont., for 1905.

Day.	June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1		[a]8.5		0		[a]12
2		[a]8.5		0	3.35	12.7
3		[a]8.5		0		[a]12
4		[a]8.0		0		[a]12
5		[a]8.0		0		[a]12
6		[a]8.0		0		[a]12
7		[a]7.5		0		[a]13
8		[a]7.5		0		[a]13
9		[a]7.5	0	0		[a]13
10		[a]7.0		[a]13	3.5	13
11		[a]7.0	3.43	12		[a]13
12		[a]7.0		[a]13		[a]12
13		[a]6.0		[a]13		[a]10
14		[a]6.0		[a]11		[a]8.6
15		[a]6.0		[a]9	2.9	6
16	2.8	5.9		[a]7		[a]5
17		4.3		[a]0		[a]4
18		3.0	1.7	0.1		0
19		2.0		0		0
20		1.0		0		0
21	0	0		0		0
22		0		0		0
23		0		0	.0	0
24		0		0		0
25		0		0		0
26		0		0		0
27		0		0		0
28		0		0		0
29		0	.0	0		0
30		0		0		0
31				12		0

[a] Estimated.

Estimated monthly discharge of West Fork ditch near Chinook, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June	8.5	0	4.2	250
July	13.0	0	2.9	179
August	13.0	0	5.9	364

DOWEN & BUCKLEY DITCH NEAR CHINOOK, MONT.

This ditch, which heads in Canada about 150 feet north of the international boundary, diverts water from North Fork of Milk River at a point about 30 miles north of Chinook, Mont.

Construction was begun on the dam and ditch in 1902, and the works now consist of an earth and rock dam, three flumes, and about 2 miles of ditch. About 40 acres of land were irrigated from the ditch in 1905, and it is probable that 150 acres will ultimately be reclaimed. The water filing attaching to this ditch is for a flow of 12 second-feet, but the

owners testified in a lawsuit that only 50 miner's inches, or 1.25 second-feet, have ever been diverted. September 20, 1905, the ditch was visited and a cross section and the slope were determined, from which the capacity of the ditch was estimated at 7.5 second-feet.

ROKITA DITCH NEAR CHINOOK, MONT.

The Rokita ditch diverts water from North Fork of Milk River at a point about 27 miles north of Chinook, Mont. The dam is well constructed of earth and rock, and the ditch is about 2 miles long. About 40 acres are irrigated at present, but more land will soon be brought under the ditch. Information is lacking in regard to the date and amount of water filing, as well as the date on which construction was commenced.

This ditch was visited September 20, 1905, and a cross section and the slope were measured, from which the capacity is estimated at 6 second-feet.

CORREGAN DITCH NEAR CHINOOK, MONT.

The Corregan dam is located in North Fork of Milk River at a point about 22 miles north of Chinook, Mont., and 8 miles below the Dowen & Buckley dam. The head-gates are 5 feet wide and 2.5 high, and the ditch is completed for 2 miles. The upper 1,500 feet are located in a slough, and the ditch is carried across North Fork in a flume about 150 feet long. An appropriation of 20 second-feet was made in October, 1901, and construction was begun on the ditch in 1902. About 55 acres of land are being served at present and probably 150 acres will eventually be irrigated from this ditch. Henry Corregan testified in court that he has used about 100 miner's inches, or 2.5 second-feet, since 1902.

The ditch was visited September 20, 1905, and cross sections and slopes were taken at two different points, from which the capacity of the ditch is estimated at 6 second-feet.

WINTER-ANDERSON CANAL NEAR CHINOOK, MONT.

This canal diverts water from the south side of Milk River at a point about 3 miles southeast of Chinook, Mont. Construction was begun in October, 1900, and a filing was made at that time for 100 second-feet of water. An appropriation of 12 second-feet, dating back to March, 1896, is also claimed for this ditch by Henry Winter. This appropriation was originally made by other parties, whose rights were acquired by Winter in September, 1896. Probably 2,500 acres could be irrigated from the Winter-Anderson canal, but it carried no water during 1905.

This canal was visited October 11, 1905, and from the cross section and slope which were then taken the capacity of the canal was estimated at 45 second-feet.

PARALLEL CREEK DITCHES NEAR HARLEM, MONT.

In the vicinity of Harlem, Mont., are a number of ditches used to divert water from Parallel Creek, a stream which usually discharges a large amount of water in March and April, but goes dry early in the season. A considerable body of land is irrigated from this creek.

The principal ditches are the Nystrom, Fox, Everett & Smith Company, and Forbes.

ROCK CREEK CANAL NEAR HINSDALE, MONT.

This canal is owned by a corporation composed of farmers in the lower Milk River Valley. It diverts water from the east side of Rock Creek, a tributary of Milk River from the north. The head-gates are situated about 7 miles north of Hinsdale, Mont , and the general course of the canal is southerly. The canal is used to irrigate extensive areas north of the river and east of Rock Creek.

The gaging station was established July 5, 1905. It is located about 300 feet below the head-gates of the canal.

The channel is straight for 100 yards above and 200 yards below the section. Both banks are nearly vertical and are composed of earth. The bed is composed of soft mud, with a

very small amount of vegetation, and probably shifts slightly. The current has a velocity of about 1 foot per second in ordinary stages.

Discharge measurements are made by wading about 10 feet below the gage. The initial point for soundings is a stake set in the west bank about 2 feet from the water's edge.

The gage, which was read twice each day by F. E. Halbert from the time of its establishment to the end of the irrigation season, is a vertical rod driven into the bed of the canal near the left bank. The gage is referred to bench marks as follows: (1) The head of a 10-penny nail driven into a notch cut in a large cottonwood tree 100 feet east of the gage; elevation, 8.43 feet above the datum of the gage. (2) The head of a 10-penny nail driven into a notch cut in a large cottonwood tree 150 feet northeast of the gage; elevation, 8.74 feet above the datum of the gage.

Discharge measurements of Rock Creek canal near Hinsdale, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 5	C. T. Prall	24.5	30.1	1.02	1.0	30.7
July 24	W. B. Freeman	21.5	9.4	.26	.19	2.5
August 12	do	21.5	13.1	.51	.3	6.7

Daily gage heights, in feet, and discharge, in second-feet, of Rock Creek canal, near Hinsdale, Mont., for 1905.

Day.	July.		August.		Day.	July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
1	.....	31	1.25	41	17	0.68	18	0.2	0
2	.....	31	.95	29	18	.5	12	.....	0
3	.....	31	.9	27	19	.4	9	.....	0
4	.....	31	.8	23	20	.38	8	.....	0
5	1.0	31	.7	19	21	.3	6	.....	0
6	.95	29	.65	17	22	.25	5	.....	0
7	1.0	31	.58	15	23	.25	5	.....	0
8	.95	29	.5	12	24	.2	3	.....	0
9	.85	25	.42	9	25	.1	1	.....	0
10	.7	19	.4	9	26	1.4	48	.....	0
11	.65	17	.35	7	27	1.4	48	.....	0
12	.62	16	.3	6	28	1.25	41	.....	0
13	.5	12	.25	5	29	1.3	44	.....	0
14	.42	9	.2	3	30	1.3	44	.....	0
15	.4	9	.12	2	31	1.2	39	.....	0
16	.48	11	.08	1					

Estimated monthly discharge of Rock Creek canal near Hinsdale, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July	48	1	22	1,353
August	41	0	7.3	438

SEEPAGE MEASUREMENTS.

MILK RIVER, MONTANA.

During the week beginning June 4, 1905, a series of measurements were made by L. R. Stockman, assistant engineer, along Milk River from the head-gates of the Milk River canal, located about 20 miles northwest of Sweet Grass, down the river to a point 2 miles below the Canadian police station. This distance is approximately 50 miles. Other measurements were made from the point where Milk River enters Montana as far down as Havre. This distance is about 60 miles.

Seepage measurements of Milk River, Montana, June, 1905.

Day.	Location.	Distance.[a]	Discharge.	Gain or loss.	
				Total.	Per mile.
		Miles.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
9	Head-gates	0	49.0	.....	.....
9	Milk River	10	56.5	+7.5	+0.75
10	Logan's ranch	16	51.4	−5.1	− .32
10	Young's ranch	10	47.2	−4.2	− .42
10	Sickler's ranch	14	43.9	−3.3	− .24
6	Canadian line	75	39.9	−4.0	− .053
6	Simpson's ranch	15	37.0	−2.9	− .20
5	Dam site	19	33.3	−3.7	− .20
5	Deserted ranch	15	41.6	+8.3	+ .55
5	Havre	10	44.6	+3.0	+ .30

[a] Distances from point to point, measured along the river.

CUTBANK CREEK, MONTANA.

August 21 and 22, 1905, a series of measurements were made by H. M. Morse, engineering aid, along Cutbank Creek, for the purpose of determining the seepage loss, from a point about 20 miles above the town of Cutbank, near the ranch of John Bird, to Cutbank.

Seepage measurements of Cutbank Creek, Montana, August, 1905.

Day.	Location.	Distance from Cutbank.	Discharge.	Gain or loss.	
				Total.	Per mile.
		Miles.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
21	John Bird's ranch	20	42.5	.....	.....
21	Gilham's ranch	15	37.0	−5.5	−1.1
21	Stockman's camp, 1 mile above Bud Ellison's ranch	11	40.6	+3.6	+ .9
22	2 miles below Bud Ellison's ranch	8	35.6	−5.0	−1.4
22	5 miles from Cutbank and 1 mile above point where reservation fence crosses creek	5	34.2	−1.4	− .47
22	Cutbank	0	33.0	−1.2	− .27

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements made in Milk River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 16	Milk River [a]	Yantic, Mont					[b] 1.0
July 1	do.[a]	do					[b] .2
July 12	do.[a]	do					[b] .2
July 20	do.[a]	do					[b] .3
July 28	do.[a]	do					[b] .5
July 29	do.[a]	do					[b] 60
August 3	do.[a]	do					[b] 4.0
August 8	do.[a]	do					[b] 1.0
August 15	do.[a]	do					[b] .2
August 23	do.[a]	do					[b] .0
June 17	Milk River [c]	Chinook, Mont					[b] 3.0
June 24	do.[c]	do					[b] 3.0
July 8	do.[c]	do		127.0	1.07		136
July 15	do.[c]	do		7.4	.93		8.0
July 21	do.[c]	do					[b] 7.0
July 27	do.[c]	do					[b] 450
August 5	do.[c]	do					[b] 200
August 11	do.[c]	do		38.0	1.38		53
August 19	do.[c]	do					[b] 8.0
June 17	Milk River [d]	Zurich, Mont					[b] 1.5
June 24	do.[d]	do					[b] 2.0
July 8	do.[d]	do	108	184.0	.98		180
July 15	do.[d]	do					[b] 5.0
July 21	do.[d]	do					[b] 4.0
July 27	do.[d]	do					[b] 350
August 5	do.[d]	do	68	90.0	2.32		209
August 11	do.[d]	do	24	19.0	1.88		35
August 19	do.[d]	do					[b] 6.0
August 25	Agency ditch [e]	Fort Belknap Agency, Mont.		21.0	.68		15.0
July 14	Milk River [f]	Harlem, Mont					[b] 4.0
July 28	do.[f]	do	75	380.0	1.08		409
August 4	do.[f]	do					[b] 50
August 17	do.[f]	do					[b] 5.0
August 25	do.[f]	do					[b] 1.0
September 5	do.[f]	do					[b] 2.0
July 24	Milk River	Hinsdale, Mont					[b] 40
August 12	do	do					[b] 65
July 5	Rock Creek [g]	do		23.5	.62	2.0	14.0
July 24	do.[g]	do				1.58	[b] .5
August 12	do.[g]	do				1.6	[b] .5
July 18	West Fork of Milk River.[h]	Chinook, Mont					[b] 9.0
July 11	West Fork of Milk River.[i]	do					[b] 1.0
July 18	do.[i]	do					[b] 7.0

[a] Estimated just below the head of the Fort Belknap canal.
[b] Estimated.
[c] Measured just below the head of the Paradise Valley canal.
[d] Measured just below the head of the Harlem canal.
[e] Measured 1½ miles below head-gates.
[f] Measured just below head of the agency ditch.
[g] Measured just below head of the Rock Creek canal.
[h] Measured below head of the Reservation ditch.
[i] Measured below all diversions.

Miscellaneous discharge measurements made in Milk River drainage basin in 1905—Continued.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 28-29	West Fork of Milk River.[a]	Chinook, Mont					[b] 200.0
August 2	do.[a]	do		36.0	0.67		24.0
August 8	do.[a]	do		87.0	.44		38.0
August 10	do.[a]	do		33.0	.60		20.0
August 11	do.[a]	do					[b] 15.0
August 15	do.[a]	do					[b] .5
August 23	do.[a]	do					[b] .5

[a] Measured below all diversions. [b] Estimated.

MUSSELSHELL RIVER DRAINAGE BASIN.

MUSSELSHELL RIVER AT SHAWMUT, MONT.

Musselshell River heads in the Little Belt Mountains, not far from White Sulphur Springs, Meagher County, Mont., runs eastward between the Big Snowy Mountains and the Bull Mountains in a course approximately parallel to that of the Yellowstone to about 107° 30′ west longitude, and then turns northward to the Missouri.

The gaging station was established August 12, 1902, for the purpose of determining the amount of water available for irrigation and storage. It is located at Crawford's ranch, one-eighth mile from the post-office at Shawmut, Mont., and 25 miles east of Harlowtown.

The channel is straight for 150 feet above and below the station. The right bank is high and steep and covered with brush; the left is comparatively high and but slightly wooded; both banks may overflow at extreme high water. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car at the new gage. The initial point for soundings is the center of the post supporting the right end of the cable.

The gage is read once each day by Dwight E. Crawford. The original gage was a vertical rod spiked to a cottonwood stump on the right bank of the river, about 200 feet north of Mr. Crawford's house. April 22, 1905, a new rod gage was set into the right bank 400 feet below the old gage, the datum being 1.01 feet below that of the original gage. As the fall of the river is only 0.72 foot between the two points, the new gage reads 0.29 foot greater than the old one; readings for years previous to 1905, to be referred to the new datum, must therefore be increased by that amount. The gage is referred to bench marks as follows: (1) A 30-penny spike below a blaze in an 18-inch cotton wood tree, which stands at the corral fence 75 feet northeast of the old gage rod; elevation, 5.91 feet above zero of the old gage and 6.92 feet above zero of the new gage. (2) A 10-penny spike in a 6-inch cottonwood tree 60 feet southeast of the old gage rod; elevation, 6.14 feet above zero of the old gage and 7.15 feet above zero of the new gage. (3) A bolt in the post supporting the measuring cable at the right bank, established April 22, 1905; elevation, 4.87 feet above zero of the new gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 84, p 31; 99, pp 111-112; 130, p 113.
Discharge: 130, p 114.
Gage heights: 84, p 32; 99, p 112; 130, p 114.

Discharge measurements of Musselshell River at Shawmut, Mont., 1904–5.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
November 8	L. R. Stockman	.....	53	1.38	[a] 1.44	74
1905.						
April 23	J. H. Sloan	55	69	.95	1.01	66
May 15	do	55	70	1.18	1.20	83
June 20	do	72	159	2.35	2.25	376
August 7	do	63	61	.98	1.00	60
September 22 [b]	do	.....	1.6	1.10	.40	1.8

[a] Referred to new datum. [b] Made at different section.

Daily gage height, in feet, of Musselshell River at Shawmut, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.45	1.6	1.9	1.2	0.95	1.6	2.5	2.4	0.55	0.45	0.95	1.1
2	1.45	1.6	1.6	1.2	.9	1.9	2.3	2.0	.55	.45	1.0	1.1
3	1.45	1.6	1.6	1.2	.9	2.3	2.1	1.85	.55	.45	1.1	1.1
4	1.45	1.6	1.55	1.2	1.0	2.6	1.9	1.5	.55	.45	1.05	1.1
5	1.45	1.6	1.5	1.2	1.05	4.58	1.8	1.3	.55	.45	1.05	1.1
6	1.45	1.6	1.5	1.2	1.05	3.78	1.7	1.15	.55	.45	1.05	1.1
7	1.45	1.65	1.55	1.2	1.05	3.4	1.5	1.1	.55	.45	1.05	1.1
8	1.45	1.7	1.5	1.2	1.0	3.4	1.3	.95	.55	.45	1.05	1.1
9	1.45	1.7	1.4	1.3	1.0	4.13	1.3	.85	.5	.45	1.05	1.1
10	1.45	1.7	1.4	1.3	1.0	3.2	1.2	.8	.5	.45	1.05	1.1
11	1.45	1.7	1.3	1.3	1.55	3.6	1.05	.75	.5	.5	1.05	1.1
12	1.45	1.7	1.2	1.3	1.5	3.3	.9	.75	.5	.5	1.05	1.1
13	1.45	1.7	1.2	1.3	1.4	3.3	.8	.7	.45	.5	1.05	1.1
14	1.45	1.7	1.1	1.25	1.3	3.25	.7	.7	.45	.6	1.04	1.1
15	1.45	1.7	1.4	1.25	1.2	3.1	.65	.65	.45	.6	1.04	1.1
16	1.45	1.7	1.3	1.25	1.15	2.75	.6	.65	.45	.6	1.04	1.1
17	1.45	1.7	1.3	1.25	1.1	2.7	1.9	.65	.45	.6	1.0	1.1
18	1.45	1.7	1.3	1.2	1.1	2.6	.8	.65	.45	.7	1.0	1.1
19	1.45	1.7	1.3	1.2	1.2	2.4	.65	.6	.45	.8	1.01	1.1
20	1.45	1.7	1.3	1.2	1.3	2.2	.6	.6	.45	.8	1.01	1.1
21	1.45	1.7	1.25	1.15	1.3	2.1	.6	.6	.45	1.0	1.0	1.1
22	1.5	1.7	1.25	1.15	1.3	2.2	.55	.6	.45	1.1	1.0	1.1
23	1.5	1.75	1.2	.95	1.3	2.3	.55	.6	.4	1.0	.9	1.1
24	1.5	1.8	1.2	1.0	1.3	2.35	.55	.6	.4	1.05	.9	1.05
25	1.5	1.8	1.2	1.0	1.3	2.4	.55	.6	.4	1.05	.9	1.0
26	1.5	1.8	1.2	1.0	1.3	2.4	.85	.6	.4	1.0	1.0	1.0
27	1.5	1.9	1.2	1.0	1.3	2.6	.7	.6	.4	1.0	1.1	1.0
28	1.5	2.05	1.2	.95	1.3	2.45	.7	.6	.4	1.0	1.1	1.0
29	1.6	.....	1.2	.95	1.5	2.25	.9	.55	.4	.9	1.1	1.0
30	1.6	.....	1.2	.95	1.5	2.1	.9	.55	.4	.9	1.1	1.0
31	1.6	.....	1.2	.....	1.5	.....	4.18	.55	.....	.8	.....	1.0

NOTE.—All gage heights refer to the datum established April 22, 1905.

From January 1 to February 12 the river was frozen entirely across; from February 13 to February 28 there was an open channel; the river was clear on March 1. Average thickness of ice, 0.8 foot. The river was frozen also from November 27 to December 31. Thickness of ice, 0.6 foot, approximately. During frozen period gage heights are to the top of the ice.

LITTLE MUDDY RIVER DRAINAGE BASIN.

LITTLE MUDDY RIVER NEAR WILLISTON, N. DAK.

Little Muddy River rises in the northwestern part of Williams County, N. Dak., and flows southward into Missouri River at Williston.

The gaging station was established February 4, 1904. It is located in sec. 19, T. 155 N., R. 100 W., the gage in the southwest quarter and the cable in the northeast quarter, about 7 miles by road from Williston, N. Dak.

The channel is straight for about 200 feet above and 1,700 feet below the station. Both banks are high and clean and do not overflow. The bed of the stream is composed of silt and is fairly permanent. There is but one channel at all stages, and the current is sluggish.

Discharge measurements are made at high stage by means of a cable, car, and tagged wire. The initial point for soundings is a point 0.5 foot behind the top of the cable support at the right bank. At low stages measurements are made by wading a few rods below the gage.

A standard chain gage, which was read during 1905 by W. O. Hollar, is attached to a timber projecting horizontally over the stream near the house of the observer. The length of the chain is 22.23 feet. The gage is referred to bench marks as follows: (1) A post driven flush with the surface of the ground under the projecting timber of the gage and marked with a brass-headed nail in the top; elevation above the datum of the gage, 2.92 feet. (2) A horizontal line of four medium-sized spikes driven into the end of a log in the wall of the log house about 4 rods west of the chain gage at the corner nearest to it and about 3 feet above ground; elevation above gage datum, 13.00 feet.

An inclined rod gage reading from 1.8 to 10.3 feet was established about 6 rods above the chain gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No 130 of the United States Geological Survey, pages 114–117.

Discharge measurements of Little Muddy River near Williston, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 5	F. C. Davis	8.0	6.9	2.32	2.60	16.0
April 25 [a]	Chandler and Turner	22	9.8	0.97	2.50	9.5
April 25	do	7.8	5.3	1.72	2.45	9.1
April 25 [a]	do	15.5	6.2	1.47	2.45	9.1
May 23	R. Richards	8.5	7.2	2.43	2.54	17.5
June 22	F. C. Davis	8.0	7.2	2.12	2.50	15.3
July 25	Hanna and Chandler	8.0	6.8	1.71	2.57	11.6
September 20	E. F. Chandler	7.5	4.5	1.32	2.39	5.9

[a] Made at different section.

Daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.9	2.6	2.5	2.5	2.6	2.5	2.4	2.6	2.5
2	3.9	2.6	2.5	2.5	2.6	2.5	2.5	2.6	2.5
3	3.9	2.6	2.5	2.5	2.6	2.5	2.5	2.6	2.5
4	3.9	2.5	2.5	2.55	2.6	2.5	2.5	2.5	2.5
5	3.8	2.5	2.5	3.2	2.6	2.5	2.4	2.5	2.5
6	3.6	2.5	2.5	3.45	2.6	2.5	2.4	2.5	2.5
7	3.5	2.5	2.5	3.2	2.6	2.5	2.4	2.5	2.5
8	3.2	2.5	2.5	3.1	2.6	2.5	2.4	2.5	2.5
9	3.0	2.5	2.5	2.95	2.6	2.5	2.4	2.5	2.5
10	3.0	2.4	2.5	2.8	2.6	2.5	2.4	2.5	2.5
11	2.9	2.4	2.5	2.8	2.6	2.4	2.4	2.5	2.5
12	2.9	2.4	2.5	2.7	2.6	2.4	2.4	2.5	2.5
13	2.9	2.4	2.5	2.6	2.6	2.4	2.4	2.5	2.5
14	2.9	2.4	2.5	2.6	2.6	2.4	2.4	2.5	2.5
15	2.8	2.4	2.5	2.6	2.6	2.4	2.4	2.5	2.5
16	2.8	2.4	2.5	2.6	2.6	2.4	2.4	2.5	2.5
17	2.8	2.4	2.5	2.6	2.6	2.4	2.4	2.5	2.5
18	2.7	2.4	2.5	2.6	2.6	2.4	2.4	2.5	2.5
19	2.8	2.5	2.5	2.5	2.6	2.4	2.4	2.5	2.5
20	2.7	2.5	2.5	2.6	2.6	2.4	2.4	2.5	2.5
21	2.7	2.5	2.5	2.6	2.6	2.4	2.4	2.5	2.5
22	2.7	2.5	2.5	2.5	2.6	2.4	2.4	2.5	2.5
23	2.7	2.5	2.5	2.5	2.6	2.4	2.4	2.5	2.6
24	2.6	2.5	2.5	2.5	2.5	2.4	2.4	2.5	2.6
25	2.6	2.5	2.5	2.5	2.6	2.4	2.4	2.5	2.6
26	2.6	2.5	2.5	2.5	2.6	2.4	2.4	2.5	2.6
27	2.6	2.5	2.5	2.5	2.6	2.4	2.4	2.5	2.6
28	2.6	2.5	2.5	2.65	2.5	2.4	2.4	2.5	2.5
29	2.6	2.5	2.5	2.65	2.5	2.4	2.4	2.5	2.5
30	2.6	2.5	2.5	2.6	2.5	2.4	2.4	2.5	.....
31	2.6	.....	2.5	.....	2.5	2.4	.....	2.5	.....

NOTE.—River frozen over January 1 to February 28; also November 30 to December 31.

Station rating table for Little Muddy River near Williston, N. Dak., from February 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	6	3.40	137	4.30	423	5.20	794
2.50	10	3.50	162	4.40	461	5.30	839
2.60	16	3.60	189	4.50	500	5.40	885
2.70	23	3.70	218	4.60	539	5.50	932
2.80	32	3.80	249	4.70	579	5.60	980
2.90	43	3.90	281	4.80	620	5.70	1,030
3.00	57	4.00	315	4.90	662	5.80	1,082
3.10	74	4.10	350	5.00	705	5.90	1,135
3.20	93	4.20	386	5.10	749	6.00	1,189
3.30	114						

The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904–5. It is fairly well defined between gage heights 2.4 feet and 5.4 feet; above 6 feet it is estimated.

Estimated monthly discharge of Little Muddy River near Williston, N. Dak., for 1905.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	200	16	58.8	3,615	0.074	0.085
April	16	6	9.4	559	.012	.013
May	10	10	10.0	615	.012	.014
June	150	10	28.1	1,672	.035	.039
July	16	10	15.0	922	.019	.022
August	10	6	7.3	448	.0091	.010
September	10	6	6.4	381	.0080	.0089
October	16	10	10.6	652	.013	.015
November	16	10	11.0	633	.014	.015
The period				9,500		

YELLOWSTONE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The upper Yellowstone rises in the Shoshone Mountains, in northwestern Wyoming, near the southeast corner of the Yellowstone National Park, flows northwestward for 40 or 50 miles, and then enters Yellowstone Lake, which may be considered the great source of the main river. This lake is about 15 miles long by 20 miles wide, lies at an elevation of 7,778 feet above the sea, and is hemmed in on every side by lofty mountains from whose snow-covered slopes its chief supply of water must come, since it receives no important streams. Issuing from the lake at the north end, the stream flows northwestward for 10 or 15 miles, plunges over the Great Falls of the Yellowstone, and for the next 20 miles runs through the Grand Canyon, which is impassable throughout. About 80 miles from the lake it emerges from the Snow Mountains, and thence runs eastward and northeastward until it joins the Missouri at Fort Buford, N. Dak.

As it leaves the mountains the river is about 600 feet wide and 6 feet deep; thence to Clark Fork, which enters from the south about 15 miles above Billings, Mont., it is characterized by bold, sweeping curves and many islands. Between Clark Fork and the mouth of the Bighorn it is from 1,500 to 1,800 feet wide, is free from rapids, and has a current of 3 to 4 miles an hour. Between the Bighorn and the Powder the main stream increases in width to from 2,400 to 2,700 feet, and becomes turbid like the Missouri. Below the mouth of the Powder the banks are low and caving, and the stream contains some rapids and shoals and numerous densely timbered islands.

The length of the Yellowstone is about 500 miles; the area of the basin is approximately 67,500 square miles.

Of the tributaries of the Yellowstone the most important is the Bighorn, which has its source in the many small streams draining the intersecting slopes of the Wind River and Shoshone mountains in northwestern Wyoming, about 30 miles southeast of Yellowstone National Park. For approximately 75 miles it flows southeastward, its volume being constantly augmented by small streams from the south heading well back in the Wind River Range, but receiving no important additions from the north. In this portion of its course it is called Wind River; but at its southernmost point it is joined by Little Wind River, turns abruptly to the northeast, and is below known as the Bighorn. Continuing in a winding course for about 15 miles, it then turns directly north, passes through a deep canyon in the Owl Creek Range, crosses Bighorn County, Wyo., into Montana, and joins the Yellowstone about 30 miles north of Fort Custer. The basin is almost surrounded by high mountain

ranges, including the Shoshone and Owl Creek mountains on the north of Wind River, the Wind River, Sweetwater, and Granite ranges on the west and south, and to the east a low range of broken hills which extend to the high plateau forming the divide between the Bighorn and the Powder and North Platte river basins. The reduced Shoshone Indian Reservation is drained by Wind River, while the Crow Reservation is located near the mouth of the Bighorn. On the Indian lands several large canals are being constructed and the science of irrigation is being taught. The soil on the Rocky Mountain slopes is generally a sandy loam, but in the narrow tributary valleys the soil is deeper and of an alluvial character.

The principal tributaries of the Bighorn are, first, Wind, Little Wind, and Popo Agie rivers, which combined carry the great perennial discharge and become the head waters; below the mouth of the Little Wind are Muskrat, Poison, and Badwater creeks, which drain the sand hills to the east, Muddy Creek, which follows the foothills of the Owl Creek Range, Gooseberry Creek, Gray Bull Creek, No Wood Creek, and Shoshone and Little Bighorn rivers.

The Shoshone rises on the eastern slope of the Shoshone Mountains, east of the Yellowstone National Park. It has two chief upper branches, North and South forks, which unite just before entering Shoshone Canyon, at a point about 12 miles southwest of Cody. From the junction of the forks the course of the main river is a little east of northeast to the Bighorn. The head-water region is very mountainous, many of the peaks, which are never entirely free from snow, rising to elevations of nearly 11,000 feet. The valley of North Fork is very narrow and the area of agricultural land in its lower reaches comprises but a few hundred acres. The valley of South Fork is perhaps 2 miles wide at its mouth, gradually narrowing for 10 or 15 miles until it becomes a gulch or canyon. There are 2,000 or 3,000 acres of land under some stage of cultivation. From these two forks the Shoshone receives 99 per cent of all the run-off carried by the stream at any point. The lower basin, on the north of the river, soon flattens out to a low plain with a gentle slope to the southeast; to the south there is a small level bench immediately below Cody, which is soon closed in by a broken headland, spreading out again farther downstream, where another large tract of irrigable land is to be found. Throughout its length the Shoshone is a rapid stream, the fall being very great. On the first benches the soil is a sandy loam resting upon gravel. Salt sage and an extremely light growth of grasses cover the valleys. The site of the Shoshone storage dam, one of the projects of the Reclamation Service, is in Shoshone Canyon about 6 miles west of Cody.

Information in regard to this basin is contained in Annual Reports of the United States Reclamation Service and in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin):

Description: Ann 11, ii, pp 36-38; 12, ii, pp 237-238; 20, iv, pp 246-247; 21, iv, p 190; Bull 131, p 26.
Irrigation surveys: Ann 13, iii, pp 63-73.
Rainfall data: Ann 13, iii, pp 67-68.

YELLOWSTONE RIVER NEAR LIVINGSTON, MONT.

This station was established May 2, 1897. It is located at Carter's bridge, 5 miles south of Livingston, Mont., at the mouth of the lower canyon.

The channel is straight for 100 yards above and below the station. The right bank is low and in flood season a part of the water escapes through a slough on that side, beginning at gage height 4.65 feet. This water is measured separately at the bridge over the slough 125 yards away. The left bank is high and will not overflow. The current is swift.

Discharge measurements are made from the downstream side of the bridge. At high water a stay line is necessary to keep the meter submerged. The initial point for soundings is marked on the guard rail 2 feet east of the center of the northwest pier, which is at the left bank.

Gage readings are taken once each day by Mrs. W. O. Cowan. A vertical rod was first installed, but was replaced by a wire gage located on the lower side of the east span. January 1, 1903, the gage datum was lowered 3 feet, increasing all subsequent readings by that

amount. In April, 1904, the wire gage was replaced by a standard chain gage having the same datum. The length of the chain is 20.77 feet. The gage is referred to bench marks as follows: (1) The head of a 2-inch nut on the center pin at the foot of the end diagonal of the upstream truss of the east pier; elevation, 17.60 feet above the new datum. (2) A white paint mark on the corner of the top of the shoe at the foot of the batter post on the east end of the upstream side of the bridge; the batter post is marked in white paint "B. M. 14.20," it is also marked in red paint "17.20;" elevation above the new gage datum, 17.20 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 15, p 74; 27, p 69; 37, pp 210-211; 49, p 268; 66, p 22; 84, pp 24-25; 99, p 97; 130, p 117.
Discharge: Ann 20, iv, p 247; WS 15, p 74; 37, p 211; 49, p 268; 66, p 22; 84, p 25; 99, p 98; 130, p 118.
Discharge: monthly; Ann 19, iv, p 289; 20, iv, p 248; 22, iv, p 289; WS 75, p 122; 84, p 26; 99, p 99; 130, p 119.
Discharge, yearly: Ann 20, iv, p 53.
Gage heights: WS 15, p 74; 27, p 73; 37, p 211; 49, p 268; 66, p 22; 84, p 25; 99, p 98; 130, p 118.
Hydrographs: Ann 19, iv, p 289; 20, iv, p 248; 22, iv, p 290; WS 75, p 123.
Rating tables: Ann 19, iv, p 288; WS 27, p 76; 52, p 516; 66, p 170; 84, p 26; 99, p 99; 130, p 119.

Discharge measurements of Yellowstone River near Livingston, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29	L. R. Stockman	160	426	2.56	1.80	1,089
April 29	J. H. Sloan	179	567	3.68	2.56	2,082
May 13	do	178	543	3.50	2.50	1,900
June 6	do		1,478	6.93	6.41	10,250
July 3	do	235	1,440	6.63	6.20	9,548
August 1	do	188	842	5.05	4.12	4,252
August 30	do	182	784	3.94	3.05	3,090
September 20	do	179	540	3.49	2.52	1,884
October 28	do		490	3.13	2.19	1,536

Daily gage height, in feet, of Yellowstone River near Livingston, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.3	1.9	1.8	2.35	5.85	6.2	3.95	2.9	2.5	1.95	1.85
2	1.7	5.35	1.8	1.8	2.5	6.35	6.2	3.95	2.8	2.45	1.95	1.85
3	1.7	4.9	1.8	1.8	2.6	6.8	6.1	3.85	2.8	2.45	1.95	1.85
4	1.85	4.25	1.85	1.8	2.45	7.15	6.0	3.85	2.75	2.45	1.95	1.95
5	1.7	4.1	1.85	1.8	2.35	7.4	5.9	3.85	2.75	2.4	1.95	1.9
6	1.7	2.3	1.85	1.8	2.25	6.4	5.7	3.8	2.7	2.4	1.95	1.95
7	1.7	2.0	1.9	1.9	2.35	6.2	5.7	3.75	2.7	2.35	2.0	1.9
8	1.7	1.8	1.9	2.0	2.5	6.85	5.5	3.5	2.7	2.35	2.0	1.9
9	1.5	1.7	1.9	2.1	2.85	7.25	5.3	3.5	2.7	2.35	2.0	1.7
10	1.6	1.5	1.85	2.1	2.8	6.7	5.3	3.5	2.65	2.3	2.0	1.6
11	1.5	1.25	1.8	1.9	2.6	6.4	5.25	3.5	2.6	2.2	2.0	1.6
12	1.2	1.25	1.8	1.9	2.5	6.6	5.2	3.5	2.6	2.2	1.95	1.7
13	1.2	1.25	1.8	1.9	2.5	7.0	5.15	3.5	2.6	2.2	1.95	1.7
14	1.7	1.5	1.9	1.9	2.4	7.2	5.0	3.45	2.6	2.2	1.9	1.6
15	1.9	1.6	1.9	1.95	2.45	6.85	4.9	3.4	2.6	2.2	1.9	1.7
16	1.9	1.6	1.8	1.95	2.5	6.4	5.0	3.35	2.55	2.25	1.8	1.7
17	1.8	1.6	1.85	1.95	2.65	6.2	4.9	3.3	2.5	2.2	1.8	1.8
18	1.9	1.6	1.85	1.95	3.5	6.2	4.7	3.3	2.5	2.2	1.8	1.8
19	1.75	1.65	1.9	2.0	3.4	6.0	4.65	3.2	2.5	2.1	1.8	1.85
20	1.9	1.75	1.95	2.0	3.4	5.8	4.6	3.15	2.5	2.1	1.8	1.9
21	1.9	1.8	1.95	2.1	3.4	5.75	4.55	3.1	2.45	2.2	1.8	1.7
22	1.9	1.8	1.8	2.1	3.5	6.5	4.45	3.1	2.45	2.15	1.8	1.65
23	1.9	1.7	1.85	2.1	3.6	6.2	4.4	3.0	2.35	2.15	1.8	1.4
24	1.9	1.75	1.7	2.2	3.6	6.4	4.3	3.0	2.35	2.15	1.85	1.3
25	1.9	1.85	1.7	2.4	3.6	6.3	4.25	3.0	2.4	2.2	2.00	1.4
36	1.85	1.95	1.7	2.5	3.8	6.5	4.2	3.0	2.4	2.2	1.95	1.65
27	1.85	1.85	1.7	2.75	3.9	6.75	4.15	3.0	2.35	2.2	1.9	1.6
28	1.85	1.85	1.8	2.75	3.85	6.85	4.1	3.0	2.35	2.2	1.75	1.5
29	1.8	.....	1.8	2.5	4.25	6.5	4.05	2.95	2.35	2.1	1.45	1.6
20	1.75	.....	1.85	2.45	4.55	6.4	4.0	2.9	2.5	2.1	1.6	1.55
31	1.5	.....	1.8	.....	4.95	.....	3.95	2.9	.....	2.0	.....	1.6

NOTE.—Ice conditions February 2-14 Gage heights are to the top of the ice.

Station rating table for Yellowstone River near Livingston, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	500	2.40	1,760	3.80	3,720	5.40	7,120
1.10	560	2.50	1,890	3.90	3,880	5.60	7,680
1.20	630	2.60	2,020	4.00	4,060	5.80	8,280
1.30	700	2.70	2,150	4.10	4,240	6.00	8,900
1.40	770	2.80	2,280	4.20	4,420	6.20	9,540
1.50	850	2.90	2,410	4.30	4,600	6.40	10,200
1.60	930	3.00	2,550	4.40	4,800	6.60	10,880
1.70	1,020	3.10	2,690	4.50	5,000	6.80	11,580
1.80	1,110	3.20	2,830	4.60	5,200	7.00	12,300
1.90	1,200	3.30	2,970	4.70	5,420	7.20	13,060
2.00	1,300	3.40	3,110	4.80	5,640	7.40	13,820
2.10	1,400	3.50	3,250	4.90	5,860		
2.20	1,520	3.60	3,400	5.00	6,100		
2.30	1,640	3.70	3,560	5.20	6,600		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5, and is well defined throughout.

Estimated monthly discharge of Yellowstone River near Livingston, Mont., for 1905.

[Drainage area, 3,580 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,200	630	1,054	64,810	0.294	0.339
February (15 days)	1,250	700	1,032	30,700	.288	.161
March	1,250	1,020	1,139	70,040	.318	.367
April	2,215	1,110	1,396	83,070	.390	.435
May	5,980	1,580	2,752	169,200	.769	.887
June	13,820	8,130	10,670	634,900	2.98	.332
July	9,540	3,970	6,180	380,000	1.73	1.99
August	3,970	2,410	3,068	188,600	.857	.988
September	2,410	1,700	1,975	117,500	.552	.616
October	1,890	1,300	1,572	96,660	.439	.506
November	1,300	930	1,190	70,810	.332	.370
December	1,250	700	1,025	63,030	.286	.330
The period				1,969,000		

NOTE.—No estimate for ice period.

YELLOWSTONE RIVER NEAR BILLINGS, MONT.

This station was established May 29, 1904. It is located at the county highway bridge about 2 miles east of Billings and 200 feet below the Northern Pacific Railway bridge. A river gage is also maintained by the Department of Agriculture at the second highway bridge above, about 4 miles west of the Geological Survey station.

The channel is straight for 200 feet above and 400 feet below the station. The right bank is of gravel, slopes gradually back from the channel, and is not subject to overflow. The left bank is low and sandy, overflowing in extremely high water. The bed of the stream is composed of gravel and is free from vegetation. There is but one channel at all stages, and the current is swift. The masonry piers of the railway bridge, 200 feet above, and an island, 400 feet below, have considerable effect on the direction of the current.

Discharge measurements are made from the lower side of the bridge, which has three spans resting on steel-jacketed concrete piers. The initial point for soundings is on the left side of the bridge.

A standard chain gage, which is read twice each day by James E. Dickie, is attached to the bridge near the middle of the first span from the west bank. The length of the chain is 27.95 feet. The gage is referred to bench marks as follows: (1) The top of the third course of stone in the left abutment of the Northern Pacific Railway bridge; elevation above the datum of the gage, 18.99 feet. (2) The top of a nail on the end of the second bent from the west end of the highway bridge on the downstream end of the bent sill; elevation, 18.21 feet above the datum of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 120–122.

Discharge measurements of Yellowstone River near Billings, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 25	L. R. Stockman	282	1,627	1.45	1.30	2,357
April 27	J. H. Sloan	318	1,842	1.95	2.00	3,603
May 12	do	325	2,099	2.48	3.10	5,217
June 8	do	455	4,177	5.43	8.26	22,680
June 28	do	458	4,554	6.25	9.19	28,450
July 20	do	391	2,618	3.95	4.90	10,340
August 14	do	324	2,240	3.06	3.40	6,856
September 12	do	319	1,771	2.32	2.38	4,107
October 11	do	287	1,666	1.77	1.83	2,944
October 20	Morse and Sloan	318	1,762	2.12	2.10	3,733

Daily gage height, in feet, of Yellowstone River near Billings, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	4.1	5.0	0.9	2.0	6.2	8.6	4.25	2.6	2.3	2.0	2.0
2	1.1	4.1	4.95	.85	2.3	6.75	8.35	4.4	2.6	2.3	2.0	2.0
3	1.1	4.1	4.9	.8	2.3	7.2	8.05	4.15	2.6	2.3	2.0	2.0
4	1.1	4.1	4.7	.9	2.5	8.4	8.0	4.15	2.6	2.2	2.0	2.0
5	1.1	4.1	4.55	1.0	2.5	9.6	8.0	4.15	2.5	2.2	2.0	2.0
6	1.1	4.1	4.05	1.0	2.5	9.4	7.75	4.0	2.5	2.1	2.0	2.0
7	1.1	4.1	3.8	1.1	2.5	8.1	7.3	4.15	2.5	2.1	2.0	2.0
8	1.1	4.1	3.4	1.1	2.5	8.25	7.15	3.95	2.4	2.2	2.0	2.0
9	1.1	4.1	2.9	1.5	2.5	9.6	7.0	3.55	2.3	2.25	2.0	2.0
10	1.1	4.1	2.6	1.8	3.25	9.7	6.7	3.5	2.25	2.2	2.0	2.0
11	4.4	4.1	2.2	1.8	3.25	8.7	6.8	3.5	2.2	2.0	1.95	2.0
12	4.4	4.1	1.8	1.8	3.0	8.55	6.55	3.4	2.2	2.05	1.9	2.0
13	4.4	4.1	1.8	1.7	3.2	9.7	6.55	3.45	2.2	2.1	1.9	2.0
14	4.4	4.1	1.8	1.5	3.05	9.8	6.1	3.4	2.2	2.0	1.9	2.0
15	4.4	4.1	1.8	1.5	2.8	9.6	6.0	3.25	2.2	2.0	1.9	2.0
16	4.4	4.5	1.8	1.5	2.5	8.8	6.15	3.15	2.2	2.0	1.9	2.0
17	4.1	5.0	1.8	1.6	2.1	8.55	6.25	3.1	2.2	2.05	1.8	1.9
18	4.1	5.3	1.8	1.7	2.0	8.25	5.65	3.1	2.2	2.2	1.8	1.9
19	4.1	5.5	1.8	1.8	3.7	7.65	5.3	3.2	2.2	2.2	1.8	1.9
20	4.1	5.5	1.6	1.8	4.1	7.1	5.35	3.0	2.2	2.2	1.8	1.8
21	4.1	5.5	1.6	1.8	2.75	7.1	5.5	2.85	2.2	2.1	1.9	1.8
22	4.1	5.5	1.45	1.85	2.6	7.4	5.6	2.7	2.0	2.0	1.9	1.6
23	4.1	5.5	1.4	1.9	3.45	8.15	5.5	2.7	2.0	2.0	1.9	1.6
24	4.1	5.5	1.4	1.95	4.2	8.5	4.6	2.65	2.0	2.0	1.9	1.5
25	4.1	5.5	1.4	1.8	4.05	8.4	4.5	2.7	2.0	2.0	1.9	1.5
26	4.1	5.5	1.4	1.8	3.8	8.4	4.5	2.7	2.0	2.0	1.9	1.45
27	4.1	5.5	1.4	2.0	3.95	8.9	4.45	2.6	2.0	2.0	1.9	1.4
28	4.1	5.5	1.3	2.2	4.2	9.4	4.45	2.6	2.0	2.0	2.0	1.3
29	4.1	.....	1.2	2.5	4.1	8.85	4.25	2.6	2.25	2.0	2.0	1.3
30	4.1	.....	1.0	2.25	4.6	8.65	4.25	2.65	2.4	2.0	2.0	1.3
31	4.1	.....	1.0	.....	5.5	.....	4.2	2.7	.....	2.0	.....	1.3

NOTE.—Ice conditions January 1 to March 11; readings to the top of the ice. January 11 to February 22 the river was gorged below the station; thickness of ice increased from 0.2 foot to 1.8 feet. River frozen November 29 to December 31.

Station rating table for Yellowstone River near Billings, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1,800	2.70	4,860	4.40	8,790	7.20	18,470
1.10	1,940	2.80	5,085	4.50	9,050	7.40	19,340
1.20	2,085	2.90	5,310	4.60	9,320	7.60	20,250
1.30	2,235	3.00	5,535	4.70	9,600	7.80	21,200
1.40	2,390	3.10	5,760	4.80	9,890	8.00	22,190
1.50	2,550	3.20	5,985	4.90	10,190	8.20	23,190
1.60	2,715	3.30	6,210	5.00	10,500	8.40	24,190
1.70	2,885	3.40	6,435	5.20	11,140	8.60	25,190
1.80	3,060	3.50	6,660	5.40	11,810	8.80	26,200
1.90	3,240	3.60	6,885	5.60	12,490	9.00	27,260
2.00	3,425	3.70	7,110	5.80	13,190	9.20	28,360
2.10	3,615	3.80	7,335	6.00	13,890	9.40	29,490
2.20	3,810	3.90	7,565	6.20	14,590	9.60	30,660
2.30	4,010	4.00	7,800	6.40	15,300	9.80	31,860
2.40	4,215	4.10	8,040	6.60	16,050	10.00	33,060
2.50	4,425	4.20	8,285	6.80	16,840		
2.60	4,640	4.30	8,535	7.00	17,640		

The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1904-5. It is fairly well defined between gage heights 1 foot and 5 feet, being based on two flood measurements above 5 feet.

Estimated monthly discharge of Yellowstone River near Billings, Mont., for 1905.

[Drainage area, 11,180 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 12-31	3,060	1,800	2,612	103,600	0.234	0.174
April	4,425	1,535	2,747	163,500	.246	.274
May	12,150	3,425	5,943	365,400	.532	.613
June	31,860	14,590	24,700	1,470,000	2.21	2.47
July	25,190	8,285	14,740	906,300	1.32	1.52
August	8,790	4,640	6,218	382,300	.556	.641
September	4,640	3,425	3,933	234,000	.352	.393
October	4,010	3,425	3,615	222,300	.323	.372
November 1-28	3,425	3,060	3,290	182,700	.294	.306
The period				4,030,000		

NOTE.—No estimate for ice period.

YELLOWSTONE RIVER AT GLENDIVE, MONT.

This station, established in 1893 by the United States War Department, was transferred to the Department of Agriculture, which has kept daily records of river height. When a study of the lower Yellowstone Valley was begun in 1903, this station was taken up by the United States Geological Survey, whose records begin August 1, 1903. The station is located at the steel highway bridge leading northward from Glendive, about one-fourth mile from the post-office.

The channel is straight for about 500 feet above and below the bridge. The right bank is composed of clay and gravel, is high, and is riprapped for some distance above and below the bridge; the left bank is low and bordered by sandy flats, covered with trees and brush, extending to the hills, 1 mile distant; these flats are liable to be submerged at high water. The bed of the stream is of clay and sand and shifts at every flood. At low water an island becomes visible between the third and fourth spans from the right, and at flood stages water finds its way through a slough traversing the flats on the left. The water at high stages is very deep and swift. Old piling and cribwork, remains of a former bridge, obstruct the channel on the upstream side.

Discharge measurements are made from the downstream hand rail of the bridge, which spans the channel in four spans of 300 feet each. The initial point for soundings is over the southeast pier at the right bank.

During 1905 the gage was read daily until August 31 by H. A. Sample; after that date the daily observations were taken by the local office of the United States Reclamation Service. The original United States Geological Survey gage was of the wire type, fastened to the upstream hand rail of the first span, about 200 feet from the right bank, the scale graduations being marked on the hand rail. This gage was destroyed October 24, 1904, and one month later a standard chain having the same datum was put in its place. The length of the chain is 39.48 feet. The gage is referred to bench marks as follows: (1) A point on the surface of the cement at the northwest corner of the girder on the pier under station "0;" elevation, 26.26 feet above gage datum and 2,060.6 feet above sea level. (2) The top of the west rail of the Northern Pacific Railway track at the right end of the bridge; elevation, 30.19 feet above gage datum. The elevation of the bench marks above sea level was determined from the Northern Pacific elevation of the datum rail at Terry, Mont.; this is 2,242 feet above sea level. The gage readings from 1897 until the establishment of the United States Geological Survey wire gage were referred to a "T" on the top of the southeast anchor bolt in the southeast caisson at the east end of the bridge; its elevation was 25.08 feet above gage datum. The old gage was carried away by ice April 8, 1899, and gage heights during the remainder of that year were determined by measuring down to the water surface from this bench mark. A new bridge was erected in 1901, and it is not known whether this old bench mark was disturbed or not.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 91–92; 130, pp 123–124.
Discharge: 99, p 92; 130, p 124.
Discharge, monthly: 130, p 126.
Gage heights, 99, pp 93–97; 130, pp 124–125.
Rating table: 130, p 25

Discharge measurements of Yellowstone River at Glendive, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 28	L. R. Stockman	705	2,038	2.19	0.73	4,471
April 25	J. H. Sloan	735	2,413	2.31	1.10	5,565
May 9	do	742	3,099	2.50	2.18	7,746
June 4	do	772	6,285	5.26	6.34	33,090
July 1	do	1,010	7,973	6.58	8.09	52,450
July 26	do	763	4,697	3.64	4.53	17,100
August 22	do	746	3,270	2.69	2.42	8,788
September 15	do	740	2,368	2.29	1.30	5,433
October 13	do	746	2,382	2.13	1.11	5,079

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.4	2.75	6.1	0.7	1.1	4.6	8.3	4.8	1.8	2.1	1.4	2.0
2	4.4	2.85	6.1	.6	1.4	5.7	7.9	5.4	1.8	2.2	1.4	1.6
3	4.5	2.85	6.3	.6	1.4	5.8	8.1	4.6	1.8	1.8	1.2	1.3
4	4.5	2.85	6.4	.6	1.1	6.3	8.3	4.4	1.9	1.4	1.2	1.4
5	4.6	2.85	7.5	.5	1.2	7.0	7.7	4.3	1.9	2.3	1.2	1.4
6	4.6	2.85	6.7	.5	1.3	8.2	7.2	3.9	1.8	1.8	1.2	1.5
7	4.5	2.85	6.3	.5	1.9	9.2	7.1	3.7	1.8	1.6	1.2	1.7
8	4.5	2.85	5.9	.5	2.4	9.4	6.7	3.5	1.8	1.4	1.3	3.2
9	4.6	2.85	5.3	.5	2.4	8.3	6.6	3.3	1.8	1.3	1.3	3.8
10	4.6	2.85	5.2	.4	2.2	8.8	6.4	3.1	1.7	1.2	1.3	4.0
11	4.1	2.85	5.0	.4	2.2	9.3	6.2	3.1	1.7	1.2	1.2	4.0
12	3.6	2.85	5.0	.4	2.4	9.3	6.0	3.0	1.6	1.15	1.2	3.8
13	3.3	2.95	4.9	.4	2.8	8.8	5.9	3.0	1.5	1.15	1.2	3.6
14	3.1	3.25	4.8	.9	2.9	8.1	5.9	3.0	1.4	1.2	1.2	3.4
15	3.0	3.85	4.5	.9	2.6	8.2	5.9	3.0	1.3	1.2	1.2	3.0
16	2.85	3.5	4.1	.8	2.3	8.6	5.8	3.0	1.3	1.2	1.2	2.9
17	2.75	3.3	3.7	.8	2.2	8.5	5.7	3.0	1.2	1.3	1.1	2.9
18	2.75	3.0	3.6	.8	2.0	8.2	6.0	2.9	1.3	1.3	1.1	2.8
19	2.75	2.9	1.5	.9	1.8	7.8	5.4	2.8	1.2	1.4	1.1	2.7
20	2.75	2.9	1.1	.9	1.8	7.8	5.2	2.7	1.1	1.4	1.1	2.7
21	2.75	2.9	1.1	.9	1.9	7.8	5.0	2.7	1.0	1.4	1.1	2.7
22	2.75	3.3	1.0	.9	3.3	7.0	4.9	2.7	1.0	1.4	1.1	2.7
23	2.75	3.4	1.0	.9	3.3	7.0	4.4	2.5	1.0	1.4	1.1	2.6
24	2.75	3.4	1.0	.8	3.3	6.9	4.3	2.3	1.0	1.4	1.1	2.5
25	2.75	4.1	.9	1.1	3.6	7.8	4.3	2.1	.9	1.4	1.1	2.4
26	2.75	4.5	.9	1.1	4.1	8.0	4.5	2.0	.9	1.4	1.1	2.1
27	2.75	6.9	.8	.9	4.5	7.7	4.4	1.9	.8	1.4	1.2	2.0
28	2.75	6.1	.7	.8	4.4	7.7	5.2	1.9	.8	1.4	1.3	1.9
29	2.75	.....	.7	.9	4.2	7.9	5.2	1.8	.7	1.4	3.2	1.5
30	2.75	.....	.7	1.0	4.3	8.1	5.4	1.8	.....	1.4	2.5	1.5
31	2.75	.....	.7	.....	4.3	.....	4.7	1.8	.....	1.5	.....	1.5

NOTE.—Ice conditions January 1 to March 19; also November 29 to December 31. Readings are to the top of the ice.

Station rating table for Yellowstone River at Glendive, Mont., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*
.40	3,750	2.00	7,300	3.60	12,900	6.40	32,000
.50	3,930	2.10	7,580	3.70	13,350	6.60	34,000
.60	4,120	2.20	7,860	3.80	13,800	6.80	36,000
.70	4,310	2.30	8,160	3.90	14,300	7.00	38,000
.80	4,500	2.40	8,460	4.00	14,800	7.20	40,200
.90	4,700	2.50	8,780	4.20	15,800	7.40	42,400
1.00	4,900	2.60	9,100	4.40	16,900	7.60	44,700
1.10	5,100	2.70	9,450	4.60	18,000	7.80	47,100
1.20	5,300	2.80	9,800	4.80	19,200	8.00	49,500
1.30	5,530	2.90	10,150	5.00	20,400	8.20	52,000
1.40	5,760	3.00	10,500	5.20	21,750	8.40	54,600
1.50	5,990	3.10	10,850	5.40	23,200	8.60	57,200
1.60	6,240	3.20	11,250	5.60	24,750	8.80	59,800
1.70	6,490	3.30	11,650	5.80	26,400	9.00	62,400
1.80	6,740	3.40	12,050	6.00	28,200		
1.90	7,020	3.50	12,450	6.20	30,050		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5, and is fairly well defined throughout.

Estimated monthly discharge of Yellowstone River at Glendive, Mont., for 1905.

[Drainage area, 66,090 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 20-31	5,100	4,310	4,670	111,200	0.071	0.032
April	5,100	3,750	4,374	260,300	.066	.074
May	17,450	5,100	9,663	594,200	.146	.168
June	67,800	18,000	47,970	2,854,000	.726	.810
July	53,300	16,350	29,240	1,798,000	.442	.510
August	23,200	6,740	11,110	683,100	.168	.194
September 1-29	7,020	4,310	5,751	330,800	.087	.094
October	8,160	5,200	5,917	363,800	.090	.104
November 1-28	5,760	5,100	5,294	294,000	.080	.083
The period				7,289,000		

NOTE.—No estimate for ice period.

CLARK FORK AT FROMBERG, MONT.

Clark Fork enters Yellowstone River from the south, about 15 miles southwest of Billings, Mont.

The gaging station was established June 3, 1905. It is located on the highway bridge one-half mile east of the Northern Pacific Railway station at Fromberg, Mont. One small stream, Rock Creek, flows into the river between the gaging station and its mouth.

The channel is slightly curved for 100 yards above and 300 yards below the station. The right bank is high, is covered with brush and willows, and does not overflow. The left bank is low, is sparsely wooded, and overflows during extremely high water. The bed of the

stream is composed of rock and gravel and is free from vegetation and permanent. There is but one channel and the water flows uniformly with a good velocity.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is directly over the center of the pier on the right bank.

The gage, which is read twice daily by Mrs. J. S. Tuggle, was first a temporary rod spiked to the upstream side of the central pier of the bridge. This was replaced July 25, 1905, by a standard chain gage fastened to the upstream side of the bridge not far from the center of the stream. The length of the chain is 15.24 feet. The gage is referred to bench marks as follows: (1) The top of the west end of the cap on the piling on the west bent of the bridge, upstream side; elevation, 13.36 feet above gage zero. (2) The top of a 10-penny nail driven into the base of a large cottonwood tree 120 feet southwest of the west end of the bridge; elevation, 13.06 feet above the zero of the gage.

Discharge measurements of Clark Fork at Fromberg, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 3	J. H. Sloan	209	845	4.87	6.42	4,118
June 27	do	210	970	5.91	7.25	5,730
July 25	do	185	518	3.00	4.95	1,657
August 19	do	135	370	1.98	3.98	734
September 16	do	122	309	1.34	3.53	416
October 17	do	122	289	1.30	3.47	372

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.6	4.72	3.82	3.5	3.5	3.5
2	.....	6.55	4.68	3.75	3.5	3.5	3.5
3	6.5	6.28	4.95	3.72	3.5	3.5	3.5
4	6.95	6.2	5.1	3.68	3.45	3.58	3.5
5	7.25	6.15	4.8	3.65	3.45	3.6	3.5
6	6.55	5.9	4.6	3.6	3.4	3.55	3.5
7	6.05	5.95	4.5	3.6	3.4	3.55	3.5
8	6.25	6.0	4.5	3.55	3.4	3.55	3.5
9	7.45	6.0	4.38	3.55	3.4	3.5	3.5
10	7.1	6.0	4.28	3.55	3.4	3.5	3.5
11	6.35	6.02	4.35	3.55	3.35	3.5	3.5
12	6.5	5.9	4.3	3.55	3.35	3.5	3.5
13	7.25	5.9	4.3	3.55	3.45	3.5	3.5
14	7.3	5.82	4.22	3.55	3.6	3.5	3.5
15	7.0	5.8	4.18	3.5	3.5	3.5	3.45
16	6.55	5.75	4.12	3.5	3.45	3.5	3.45
17	6.3	5.55	4.08	3.5	3.45	3.5	3.45
18	6.15	5.2	4.0	3.47	3.42	3.5	3.45
19	5.55	5.2	3.9	3.45	3.4	3.5	3.45
20	5.4	5.0	3.85	3.45	3.42	3.5	3.45
21	5.7	5.0	3.8	3.45	3.48	3.5	3.45
22	6.4	4.9	3.8	3.4	3.5	3.5	3.45
23	6.4	5.05	3.8	3.4	3.53	3.5	3.42
24	6.4	5.0	3.75	3.37	3.55	3.5	3.4
25	6.4	5.0	3.75	3.35	3.55	3.5	3.4
26	6.58	4.88	3.7	3.35	3.5	3.5	3.4
27	7.0	5.0	3.85	3.35	3.5	3.8	3.4
28	7.25	4.85	3.85	3.35	3.5	3.8	3.4
29	6.9	4.78	3.9	3.45	3.5	3.8	3.4
30	6.7	4.78	3.88	3.75	3.5	3.8	3.4
31	.....	4.72	3.85	.....	3.5	.....	3.4

NOTE.—November 27-30, rise caused by ice. River frozen November 27 to December 31; readings are to the water surface in a hole in the ice.

Station rating table for Clark Fork at Fromberg, Mont., from June 3 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	346	4.30	999	5.20	1,973	6.20	3,475
3.50	400	4.40	1,094	5.30	2,102	6.40	3,850
3.60	458	4.50	1,192	5.40	2,236	6.60	4,260
3.70	520	4.60	1,293	5.50	2,375	6.80	4,690
3.80	587	4.70	1,397	5.60	2,519	7.00	5,140
3.90	660	4.80	1,504	5.70	2,667	7.20	5,600
4.00	738	4.90	1,615	5.80	2,819	7.40	6,080
4.10	821	5.00	1,730	5.90	2,975		
4.20	908	5.10	1,849	6.00	3,135		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905 and is well defined between gage heights 3.5 feet and 7.2 feet.

Estimated monthly discharge of Clark Fork at Fromberg, Mont., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 3-30	6,200	2,236	4,294	238,500
July	4,260	1,418	2,511	154,400
August	1,849	520	924	56,820
September	602	321	421	25,050
October	458	321	381	23,430
November 1-26	458	400	407	20,990
The period				519,200

NOTE.—No estimate for ice period.

PRYOR CREEK AT HUNTLEY, MONT.

Pryor Creek rises in the Pryor Mountains, in southeastern Carbon County, Mont., flows northeastward, and enters Yellowstone River from the south about 15 miles northeast of Billings.

The station was established August 6, 1904. It is located at Huntley, the junction of the Northern Pacific and Burlington railroads, 13 miles from Billings, Mont.

No regular station for discharge measurements has yet been established; but low-water measurements have been made by wading above the gage and high-water measurements have been made from the Northern Pacific Railway bridge, 1¼ miles below.

The gage, which is read twice each day by J. W. Day, consists of a rod placed vertically at the right bank about 200 feet south of the Northern Pacific Railway station. The gage is referred to bench marks as follows: (1) The top of the rail of the Northern Pacific Railway track in front of the operator's window; elevation, 14.52 feet. (2) A nail in a pile at the foot of a large tree on the east side of the creek, opposite the station agent's house and the post-office; elevation, 11.46 feet. (3) A spike driven in a large tree 100 feet southwest of the water-tank, 150 feet north of the section house, and 40 feet east of the track; elevation, 12.79 feet. Elevations are above the zero of the gage, which is 3,014.48 feet above sea level.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 126–127.

Discharge measurements of Pryor Creek at Huntley, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 17	J. H. Sloan	12	20	1.25	1.45	26
May 12	do	16	25	2.35	1.96	59
June 5	do	40	271	7.31	14.93	1,982
June 26	do	17	26	2.66	2.20	68
July 2	do	34	148	6.34	10.52	936
August 15	do	18	16	1.21	1.20	13
September 14	do		10	1.19	1.18	12

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	3.05	4.8	1.7	1.55	2.3	7.95	1.3	1.2	2.35	1.75	2.3
2	1.65	3.25	4.4	1.7	1.75	2.45	8.1	1.7	1.2	1.8	1.75	2.3
3	1.55	3.3	3.95	1.8	1.8	2.4	5.4	1.4	1.2	1.65	1.8	2.3
4	1.7	3.4	3.75	1.65	2.15	2.3	3.4	1.3	1.25	1.6	1.9	2.3
5	1.75	3.4	3.55	1.55	3.45	12.7	2.7	1.3	1.2	1.65	1.8	2.3
6	1.65	3.4	3.3	1.65	2.1	5.25	1.85	1.3	1.3	1.55	1.7	2.3
7	1.8	3.45	3.05	1.7	1.65	3.25	1.75	1.3	1.25	1.5	1.7	2.3
8	1.95	3.55	2.65	1.6	1.55	6.3	1.7	1.3	1.2	1.45	1.7	2.3
9	2.1	3.6	2.2	1.75	2.25	8.55	1.7	1.28	1.2	1.4	1.7	2.3
10	2.15	3.6	2.0	1.85	4.8	8.1	1.6	1.25	1.2	1.65	1.7	2.3
11	2.0	3.6	1.9	2.0	3.6	3.8	1.5	1.2	1.3	1.7	1.65	2.3
12	2.15	3.6	1.8	2.05	1.95	3.5	1.6	1.2	1.25	1.6	1.7	2.3
13	2.25	3.6	1.95	2.2	1.8	3.6	1.65	1.2	1.25	1.65	1.7	2.3
14	2.2	3.6	1.85	2.1	1.75	3.55	1.7	1.2	1.3	1.85	1.6	2.3
15	2.35	3.6	1.7	2.05	1.75	3.45	1.65	1.2	1.25	2.1	1.6	2.3
16	2.3	3.7	1.85	2.05	1.7	3.5	1.55	1.2	1.2	1.8	1.65	2.3
17	2.4	3.8	2.0	1.9	1.65	3.65	1.5	1.25	1.2	1.65	1.65	2.35
18	2.2	3.95	1.9	1.85	1.85	3.8	1.4	1.2	1.2	1.6	1.7	2.4
19	2.15	4.15	1.8	1.8	2.05	3.65	1.4	1.2	1.3	1.6	1.65	2.4
20	2.25	4.2	1.65	1.55	2.3	3.25	1.3	1.2	1.3	1.6	1.6	2.4
21	2.25	4.4	1.6	1.45	2.0	3.05	1.3	1.2	1.25	1.6	1.6	2.4
22	2.3	4.5	1.7	1.4	1.9	2.8	1.3	1.2	1.2	1.95	1.7	2.4
23	2.4	4.6	1.75	1.4	2.4	2.75	1.35	1.2	1.2	1.8	1.6	2.4
24	2.4	4.75	1.6	1.5	4.05	3.05	1.35	1.2	1.3	1.75	1.7	2.4
25	2.5	5.1	1.6	1.45	2.9	3.2	1.25	1.2	1.3	1.95	1.7	2.4
26	2.5	5.2	1.7	1.4	2.45	3.05	1.3	1.2	1.25	2.1	1.7	2.4
27	2.5	5.3	1.6	1.5	2.4	3.2	1.25	1.15	1.2	2.15	1.9	2.4
28	2.5	5.15	1.6	1.45	2.3	3.3	1.2	1.2	1.25	2.3	2.05	2.4
29	2.65	.....	1.65	1.4	2.4	3.3	1.35	1.08	1.3	2.4	2.1	2.4
30	2.85	.....	1.7	1.5	2.45	3.3	1.3	1.15	2.0	1.8	2.2	2.4
31	2.9	.....	1.65	.....	2.55	.....	1.3	1.2	.....	1.8	.....	2.5

NOTE.—River frozen and readings to the top of the ice from January 8 to February 14 inclusive and from November 28 to December 31 inclusive; water flowing over the top of the ice February 15 to March 8 inclusive.

Station rating table for Pryor Creek at Huntley, Mont., from August 7, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	6	2.60	96	4.10	203	6.20	388
1.10	9	2.70	102	4.20	211	6.40	408
1.20	13	2.80	109	4.30	219	6.60	428
1.30	18	2.90	115	4.40	227	6.80	448
1.40	23	3.00	122	4.50	235	7.00	470
1.50	28	3.10	128	4.60	243	7.20	492
1.60	33	3.20	135	4.70	251	7.40	514
1.70	39	3.30	142	4.80	259	7.60	536
1.80	45	3.40	149	4.90	268	7.80	558
1.90	51	3.50	156	5.00	277	8.00	582
2.00	57	3.60	163	5.20	295	8.20	606
2.10	63	3.70	171	5.40	313	8.40	631
2.20	70	3.80	179	5.60	331	8.60	657
2.30	76	3.90	187	5.80	349	8.80	683
2.40	83	4.00	195	6.00	368	9.00	710
2.50	89						

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904-5 and is well defined between gage heights 1 foot and 2 feet. The table has been extended beyond these limits, being based on two flood measurements, one at 10.52 feet and one at 14.93 feet.

Estimated monthly discharge of Pryor Creek at Huntley, Mont., for 1904-5.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
August 7-31	16	6	8.9	441	0.011	0.010
September	18	13	16.1	958	.020	.022
October	33	16	24.7	1,519	.031	.036
November	54	18	30.8	1,833	.038	.042
December	51	25	34.1	2,097	.043	.050
The period				6,848		
1905.						
January 1-7	45	30	37.3	516	.047	.012
March 9-31	70	33	43.8	1,975	.054	.046
April	70	23	39.4	2,344	.049	.055
May	259	30	77.8	4,784	.097	.112
June	1,370	76	222	13,210	.278	.310
July	594	13	78.2	4,808	.098	.113
August	39	9	15.2	935	.019	.022
September	57	13	16.6	988	.021	.023
October	83	23	44.4	2,730	.056	.065
November 1-27	51	33	39.0	2,089	.049	.049
The period				34,380		

NOTE.—No estimate for ice period.

BIGHORN RIVER[a] AT THERMOPOLIS, WYO.

This station was established May 28, 1900. It was at first located near the hot springs on the "Mile Square, State Reservation," about half a mile northeast of Thermopolis, in T. 43 N., Rs. 94 and 95 W.; but in 1901 it was transferred to the new iron bridge 400 or 500 feet upstream from the former location.

The channel is straight for some distance above and below the station. The banks are high and do not overflow. The bed of the stream is composed of rock and gravel and is fairly permanent. At ordinary stages all of the water flows beneath the bridge proper, but at flood stages it rises under the approaches at each side. There are no obstructions in the channel above the station.

Discharge measurements are made from the bridge, which is a two-span truss structure, each span 125 feet long, with approaches on each side 15 feet long. Sounding points are marked at 10-foot intervals by brass-headed nails driven into the railing on the downstream side, beginning at the center pier, which is the initial point, and running toward either bank.

The gage is observed by William M. Neece, superintendent of the State reserve, who lives within 100 yards of the station. The gage used in 1900 was a horizontal rod extending out over the water and fastened to posts firmly set in the ground, with the usual wire and weight attachment. In 1901 a new gage, with relative heights the same as those in use in 1900, was painted on the lower center pier of the recently constructed iron bridge, 400 or 500 feet above the old gage. In March, 1903, another gage, serving as a bench mark and for the observer's use at times of high water, was painted on the lower pier of the bridge on the right bank of the river. This gage, which is not reached by the water until it stands 3 feet above datum, enables the observer to read heights of high water more accurately than they can be read on the regular gage, which is in the center of the stream and exposed to the force of the current, causing a rise and fall of several inches on the gage. In March, 1904, the regular gage was replaced by a new one, consisting of a vertical staff firmly fastened by iron bands to the pier on which the former gage was painted.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 37, p 211; 49, p 269; 66, p 23; 84, pp 23-24; 99, p 89; 130, pp 127-128.
Discharge: WS 37, p 211; 49, p 269; 84, p 24; 99, p 90; 130, p 128.
Discharge, monthly: Ann 22, iv, p 291; WS 75, p 123; 99, p 91; 130, p 130.
Gage heights: WS 49, p 269; 66, p 23; 84, p 24; 99, p 90; 130, p 129.
Hydrograph: Ann 22, iv, p 291.
Rating tables: WS 52, p 516; 66, p 170; 99, p 91; 130, p 130.

Discharge measurements of Bighorn River at Thermopolis, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 9	A. J. Parshall	177	326	1.67	0.85	545
July 10	do	252	910	5.02	3.45	4,567
July 11	do	252	938	5.15	3.60	4,827
July 12	do	252	960	5.25	3.70	5,043
July 18	C. D. Farmer	252	862	4.72	3.30	4,065
July 23	do	244	787	4.54	3.00	3,572
August 1	do	244	687	4.12	2.60	2,830
August 4	do	220	585	3.83	2.30	2,240
August 18	do	220	510	3.30	1.90	1,683
September 9	do	198	476	3.05	1.50	1,454
September 20	do	170	401	2.27	1.20	910
October 12	do	166	339	2.25	1.00	761

[a] A description of this river is included in the general description of the Yellowstone River basin, p. 91.

Daily gage height, in feet, of Bighorn River at Thermopolis, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.3	1.1	3.9	4.85	2.65	1.6	1.35	0.8	[b] 0.3
2	.3	1.1	4.65	4.75	2.55	1.55	1.5	0.8	0.3
3	.5	1.2	4.35	4.55	2.5	2.0	1.4	0.8	0.3
4	.3	1.2	4.6	4.65	2.35	1.95	1.3	0.7	0.2
5	.3	1.3	5.75	4.55	2.2	1.8	1.25	0.9	0.25
6	.3	1.4	6.2	4.35	2.45	1.9	1.35	0.8	0.4
7	.2	1.45	6.1	4.05	2.45	1.85	1.25	0.95	0.35
8	.3	1.5	6.15	3.75	2.4	1.75	1.2	0.85	0.3
9	.4	1.4	4.5	3.6	2.25	1.55	1.1	0.85	0.2
10	.55	1.3	5.5	3.55	2.2	1.5	1.1	0.9	0.4
11	.75	1.2	4.8	3.4	2.75	1.4	1.0	0.95	0.4
12	.8	1.2	3.85	3.35	2.3	1.4	1.0	0.9	0.4
13	.65	1.25	4.15	3.5	2.3	1.45	1.1	0.8	0.5
14	.6	1.3	4.45	3.65	2.25	1.3	1.1	0.8	0.45
15	.8	1.1	4.8	3.6	2.1	1.3	1.2	0.7	0.4
16	.85	1.05	4.55	3.52	2.0	1.25	1.15	0.7	0.3
17	.7	1.2	4.3	3.7	2.0	1.2	1.3	0.75	0.3
18	.7	1.05	4.45	3.6	1.95	1.25	1.2	0.75	0.3
19	.8	1.05	4.6	3.25	1.9	1.2	1.1	0.9	0.2
20	.8	1.1	4.5	2.95	1.8	1.15	1.0	0.8	0.2
21	.8	1.25	4.6	2.95	1.8	1.2	0.95	0.85	0.2
22	.9	1.4	4.45	3.15	1.7	1.15	0.9	0.9	0.3
23	.95	1.9	4.25	3.05	1.7	1.1	0.9	0.85	0.25
24	.8	2.05	3.95	2.9	1.7	1.1	0.9	0.8	0.2
25	.85	1.85	3.9	2.85	1.8	1.0	0.85	0.7	0.2
26	1.0	1.9	4.3	2.8	1.8	.95	0.9	0.7	0.2
27	1.1	2.25	4.65	2.8	1.8	1.0	0.9	0.7	0.2
28	1.0	2.7	5.05	2.85	1.9	1.0	0.8	0.65	0.3
29	1.0	4.0	5.0	2.85	1.8	1.05	0.85	[a] 0.55	0.3
30	1.05	4.15	5.05	2.8	1.7	1.25	0.9	0.45	0.4
31	.....	3.3	.....	3.15	1.65	.....	0.8	.....	0.3

[a] River frozen over. [b] River full of ice.

Station rating table for Bighorn River at Thermopolis, Wyo., from April 1 to October 14, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
.20	150	1.50	1,255	2.80	3,205	4.00	5,615
.30	205	1.60	1,375	2.90	3,390	4.20	6,045
.40	265	1.70	1,500	3.00	3,580	4.40	6,475
.50	330	1.80	1,630	3.10	3,770	4.60	6,905
.60	400	1.90	1,765	3.20	3,965	4.80	7,340
.70	475	2.00	1,905	3.30	4,165	5.00	7,780
.80	555	2.10	2,050	3.40	4,365	5.20	8,220
.90	640	2.20	2,200	3.50	4,570	5.40	8,660
1.00	730	2.30	2,355	3.60	4,775	5.60	9,100
1.10	825	2.40	2,515	3.70	4,985	5.80	9,550
1.20	925	2.50	2,680	3.80	5,195	6.00	10,000
1.30	1,030	2.60	2,850	3.90	5,405	6.20	10,450
1.40	1,140	2.70	3,025				

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905 and is well defined between gage heights 0.8 foot and 3.7 feet.

Estimated monthly discharge of Bighorn River at Thermopolis, Wyo., for 1905.

[Drainage area, 8,184 square miles.]

Month.	Discharge in second-feet.			Run-off.		
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
April	825	150	476	28,320	0.058	0.065
May	5,938	778	1,594	98,010	.195	.225
June	10,450	5,300	7,161	426,100	.875	.976
July	7,450	3,205	4,664	286,800	.570	.657
August	3,115	1,438	2,057	126,500	.251	.289
September	1,905	685	1,132	67,360	.138	.154
October	1,255	555	819	50,360	.100	.115
November	685	298	546	32,490	.067	.075
December	330	150	207	12,730	.025	.029
The period				1,129,000		

BIGHORN RIVER AT FORT CUSTER, MONT.

This station was established June 16, 1904. It is located at the bridge of the Burlington and Missouri River Railroad, about one-half mile above the junction of Bighorn and Little Bighorn rivers, near the section house at Fort Custer. The nearest post-office is 11 miles away, at Crow Agency, Mont. The nearest town is Billings, 60 miles distant.

The channel is straight for 100 hundred yards above and below the bridge. The right bank is high and does not overflow. The left is low and subject to overflow by extremely high water. The bed of the stream is of gravel and is free from vegetation. There is but one channel at ordinary stages, broken by the two piers of the bridge. The current is swift.

Discharge measurements are made from the upstream side of the three-span bridge, to which the gage is attached. The initial point for soundings is at the east or right abutment of the bridge.

During 1905 the gage has been read twice each day and four successive observers have been employed, namely, C. D. Hogue, N. N. Storm, J. R. Jahnson, and L. P. Roode. January 1, 1905, the gage datum was raised 5 feet above the 1904 datum and a standard chain gage was fastened near the middle of the first span from the east bank, the length of the chain from the bottom of the weight to the marker being 21.72 feet. October 10, 1905, the gage was moved to the west or left span of the bridge and the gage datum was lowered 2 feet. The new chain-gage length is 23.83 feet. All gage heights for 1905 are referred to the datum of January 1, 1905. The gage is referred to bench marks as follows: (1) On the top of the east concrete abutment at the south end on mark XXXIII; elevation, 16.90 feet above the datum of October 10, 1905. (2) On the top of the first concrete pier west of the east abutment on the south end of the pier on mark XXXVI; elevation, 16.85 feet above the datum of October 10, 1905. (3) On the top of the south end of the west concrete abutment on mark XXXIV; elevation, 16.88 feet above the datum of October 10, 1905. The elevation of this datum is given at 2,877.1 feet above sea level.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 131–132.

Discharge measurements of Bighorn River at Fort Custer, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 23	L. R. Stockman	418	1,295	1.17	0.55	1,510
April 26	J. H. Sloan	444	1,407	1.29	.68	1,823
May 11	do	442	1,620	2.11	1.50	3,424
June 10	do	455	3,370	7.12	5.55	24,000
June 26	do	456	2,960	5.23	4.45	15,490
July 19	do	431	2,362	3.39	2.90	8,012
August 18	do	446	1,680	2.23	1.58	3,748
September 13	do	443	1,261	1.55	.87	1,960
October 10	do	443	1,259	1.39	.73	1,747
October 31	Morse and Sloan	443	1,266	1.38	.74	1,743

Daily gage height, in feet, of Bighorn River at Fort Custer, Mont., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.7	1.55	1.8	0.4	0.73	3.9	4.48	2.2	1.1	.....	0.73	0.73
2	.65	1.55	1.82	.4	.7	3.92	4.52	2.2	1.12	2.1	.7	.78
3	.6	1.55	1.85	.4	.78	4.05	4.22	2.05	1.1	1.25	.73	.95
4	.6	1.55	1.8	.4	1.23	4.62	4.12	1.9	1.1	1.05	.73	1.0
5	.6	1.55	1.2	.35	1.58	5.0	3.98	1.9	1.1	1.0	.8	1.08
6	.6	1.6	1.2	.35	1.38	5.52	3.8	1.8	1.13	.9	.8	1.12
7	.55	1.6	1.1	.35	1.18	5.28	3.68	1.75	1.1	.88	.75	1.2
8	.55	1.6	1.1	.35	1.25	4.9	3.52	1.6	1.2	.78	.75	1.3
9	.5	1.6	1.0	.35	1.25	5.2	3.55	1.6	1.1	.7	.78	1.22
10	.5	1.6	1.0	.35	1.42	6.6	3.4	1.65	1.0	.78	.73	1.2
11	.5	1.6	.8	.35	1.52	5.28	3.38	1.62	1.0	.98	.68	1.22
12	.5	1.6	.8	.42	1.42	5.05	3.52	1.58	.9	.92	.7	1.2
13	,5	1.6	.9	.4	1.15	4.78	3.5	1.62	.93	.9	.7	1.2
14	.5	1.6	.7	.42	1.08	4.72	3.4	1.6	.87	.9	.7	1.2
15	.5	1.6	.7	.45	1.0	4.88	3.48	1.65	.85	.9	.7	1.2
16	.5	1.6	.8	.5	.9	4.85	3.4	1.68	.85	1.0	.7	1.28
17	.55	1.6	.9	.55	.85	4.82	3.2	1.55	.8	1.02	.7	1.35
18	.55	1.6	1.0	.55	.85	4.92	2.95	1.5	.8	1.0	.7	1.38
19	.6	1.6	1.0	.58	1.35	5.02	2.85	1.45	.75	.95	.7	1.35
20	.6	1.6	.9	.52	1.75	4.4	2.8	1.38	.7	.92	.7	1.42
21	.6	1.6	.9	.74	1.7	3.95	2.62	1.3	.7	.92	.7	1.48
22	1.55	1.6	.8	.78	1.78	3.75	2.48	1.28	.65	.92	.7	1.45
23	1.55	1.6	.7	.82	2.08	4.3	2.42	1.18	.63	.92	.7	1.38
24	1.55	1.6	.6	.62	3.05	4.68	2.45	1.15	.6	.93	.7	1.1
25	1.55	1.6	.52	.62	3.15	4.42	2.35	1.12	.55	.93	.7	1.1
26	1.55	1.6	.5	.62	2.62	4.35	2.3	1.1	.....	.93	.73	1.1
27	1.55	1.6	.45	.65	2.6	4.5	2.25	1.1	.....	.92	.75	1.1
28	1.55	1.7	.4	.78	2.6	4.82	2.2	1.1	.....	.98	.78	1.1
29	1.55	.....	.4	.78	2.6	4.9	2.4	1.15	.....	.93	.73	1.1
30	1.55	.....	.4	.78	3.35	4.62	2.38	1.15	.....	.88	.7	1.12
31	1.55	.....	.4	.....	4.22	.....	2.35	1.15	.....	.83	.....	1.12

NOTE.—Readings from January 22 to March 3, inclusive, and from November 28 to December 31 were taken to the surface of the ice. January 1-21, inclusive, gage height read to the water surface through a hole cut in the ice. River bed was dry under the gage September 26 to October 1, inclusive. For that reason gage was moved to deeper water. Ice thickness, January 22, 12 inches; February 20, 14 inches; February 25, 14.5 inches.

Station rating table for Bighorn River at Fort Custer, Mont., from June 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	1,260	1.60	3,660	2.80	7,460	4.00	12,780
.50	1,400	1.70	3,920	2.90	7,820	4.20	13,940
.60	1,540	1.80	4,200	3.00	8,200	4.40	15,180
.70	1,700	1.90	4,480	3.10	8,580	4.60	16,500
.80	1,860	2.00	4,780	3.20	8,980	4.80	17,900
.90	2,040	2.10	5,080	3.30	9,380	5.00	19,380
1.00	2,240	2.20	5,400	3.40	9,800	5.20	20,940
1.10	2,440	2.30	5,720	3.50	10,240	5.40	22,660
1.20	2,660	2.40	6,060	3.60	10,720	5.60	24,460
1.30	2,900	2.50	6,400	3.70	11,200	5.80	26,340
1.40	3,140	2.60	6,740	3.80	11,720		
1.50	3,400	2.70	7,100	3.90	12,240		

The above table is applicable only for open-channel conditions. It is based on fourteen discharge measurements made during 1904–5, and is fairly well defined between gage heights 0.5 foot and 4.5 feet. The table has been extended beyond these limits, being based on one measurement at 5.55 feet.

Estimated monthly discharge of Bighorn River at Fort Custer, Mont., for 1904–5.

[Drainage area, 20,720 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
June 16–30	25,290	13,940	20,670	615,000	0.998	0.557
July	17,540	8,010	12,260	753,800	.592	.682
August	7,532	2,506	4,583	281,800	.221	.255
September	3,920	1,700	2,449	145,700	.118	.132
October	1,860	1,620	1,728	106,300	.083	.096
November	1,700	1,400	1,558	92,710	.075	.084
The period				1,995,000		
1905.						
January 1–21	1,700	1,400	1,485	61,850	.072	.056
March 4–31	4,200	1,260	1,957	108,700	.094	.098
April	1,896	1,200	1,440	85,690	.069	.077
May	14,060	1,700	4,318	265,500	.208	.240
June	24,460	11,460	17,420	1,037,000	.841	.938
July	15,960	5,400	9,143	562,200	.441	.508
August	5,400	2,440	3,486	214,300	.168	.194
September 1–25	2,660	1,470	2,077	103,000	.100	.093
October 2–31	5,080	1,700	2,202	131,000	.106	.118
November 1–27	1,860	1,668	1,732	92,750	.084	.084
The period				2,662,000		

NOTE.—No estimate for ice period.

LITTLE BIGHORN RIVER AT CROW AGENCY, MONT.

This station was established March 24, 1905. It is located at the Burlington and Missouri River Railroad bridge, one-fourth mile south of Crow Agency, Mont.

The channel is straight for 200 feet above and below the station. Both banks are high and unwooded. The bed of the stream is covered with rock and gravel, is free from vegetation, and is permanent. All of the water passes between the abutments of the bridge at all stages. The velocity of the current is moderate. There are a few large rocks in the river, and about 1,200 feet above the station, at the head of Crow Agency ditch, there is a stone and brush dam.

Discharge measurements are made from the upstream side of the single-span bridge to which the gage is attached. The initial point for soundings is a nail driven in the upstream guard rail directly over the inner face of the right abutment.

Daily gage readings have been taken since the establishment of the station by three successive observers—C. C. Hutton, J. A. Smith, and Thomas W. McHoes. The standard chain gage is attached to the upstream side of the bridge, near the center of the river. The length of the chain is 20.31 feet. The gage is referred to bench marks as follows: (1) A cross on the west end of the south abutment, directly below the figures "1903;" elevation, 12.87 feet. (2) A bolt head in the guard rail on the upstream side of the bridge, 7 feet south of the gage; elevation, 19.33 feet. (3) A nail in the east end of the cap on piles supporting the railroad track over Crow Agency ditch; elevation, 14.33 feet. Elevations are above the zero of the gage.

Discharge measurements of Little Bighorn River at Crow Agency, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 24	L. R. Stockman	114	85	1.43	2.00	122
April 26	J. H. Sloan	82	83	1.51	2.00	125
May 11	do	89	165	2.77	3.10	457
June 10	do	99	326	3.85	4.50	1,253
June 26	do	92	262	3.38	4.04	885
July 18	do	87	148	1.82	2.48	268
August 18	do	83	91	1.37	2.05	124
September 13	do	82	68	1.08	1.89	74
October 19	do	83	69	1.06	1.90	72
October 30	Morse and Sloan	82	83	1.38	2.06	115

Daily gage height, in feet, of Little Bighorn River at Crow Agency, Mont., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.0	2.0	3.3	3.6	2.2	1.9	2.0	1.9	2.0
2	.....	2.0	2.0	3.4	3.6	2.2	1.9	2.0	2.0	2.1
3	.....	2.0	2.1	3.7	3.7	2.2	1.9	2.0	2.1	2.2
4	.....	2.0	2.4	3.9	.....	2.2	1.9	2.0	2.1	2.3
5	.....	2.0	2.5	4.4	.....	2.2	1.9	2.0	2.1	2.3
6	.....	2.0	2.5	5.2	.....	2.2	1.9	2.0	2.1	2.3
7	.....	2.0	2.5	5.1	.....	2.2	1.9	1.9	2.1	2.4
8	.....	1.9	2.4	5.2	.....	2.1	1.9	1.9	2.1	2.4
9	.....	2.0	2.4	5.7	.....	2.1	1.9	1.9	2.1	2.4
10	.....	2.1	2.4	4.8	.....	2.1	.....	1.9	2.1	2.3
11	.....	2.2	3.1	4.8	.....	2.1	1.9	1.9	2.1	2.3
12	.....	2.1	2.5	4.3	.....	2.1	1.9	1.9	2.1	2.4
13	.....	2.1	2.4	4.4	.....	2.1	1.9	2.0	2.1	2.4
14	.....	2.1	2.3	4.5	.....	2.1	1.9	2.0	2.1	2.4
15	.....	2.1	2.3	4.7	.....	2.1	1.9	2.1	2.1	2.4
16	.....	2.1	2.3	4.5	.....	2.1	1.9	2.1	2.1	2.4
17	.....	2.1	2.3	4.3	.....	2.1	1.9	2.1	2.1	2.4
18	.....	2.1	2.3	4.2	.....	2.1	1.9	2.1	2.1	2.4
19	.....	2.1	2.2	4.0	2.4	2.1	1.9	2.1	2.0	2.4
20	.....	2.1	2.3	3.9	2.4	2.1	1.9	2.0	2.0	2.4
21	.....	2.1	2.4	3.7	2.3	2.1	1.9	2.0	2.1	2.4
22	.....	2.1	2.3	3.7	2.3	2.0	1.9	2.1	2.1	2.3
23	.....	2.1	2.5	3.8	2.3	2.0	1.9	2.1	2.1	2.3
24	2.0	2.0	2.5	4.0	2.3	2.0	1.9	2.0	2.0	2.3
25	2.0	2.0	2.6	4.1	2.3	2.0	1.8	2.0	2.1	2.3
26	2.0	2.0	2.6	4.0	2.3	2.0	1.8	2.1	2.2	2.3
27	2.0	2.0	2.6	3.9	2.4	2.0	1.8	2.1	2.1	2.4
28	2.0	2.0	2.7	3.8	2.4	2.0	1.8	2.1	2.1	2.4
29	2.0	2.0	2.7	3.7	2.3	1.9	1.8	2.1	2.0	2.4
30	2.0	2.0	2.7	3.7	2.4	1.9	2.0	2.0	2.0	2.4
31	2.0	.....	3.0	.....	2.3	1.9	.....	2.0	.....	2.3

NOTE.—River partly frozen during December. Gage heights are to the water surface.

Station rating table for Little Bighorn River at Crow Agency, Mont., from March 24 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	60	2.70	320	3.60	675	4.50	1,110
1.90	80	2.80	355	3.70	720	4.60	1,160
2.00	105	2.90	390	3.80	765	4.70	1,210
2.10	130	3.00	430	3.90	810	4.80	1,260
2.20	155	3.10	470	4.00	860	4.90	1,310
2.30	185	3.20	510	4.10	910	5.00	1,360
2.40	215	3.30	550	4.20	960	5.20	1,465
2.50	250	3.40	590	4.30	1,010	5.40	1,575
2.60	285	3.50	630	4.40	1,060	5.60	1,685

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1905 and is well defined between gage heights 2 feet and 5 feet.

Estimated monthly discharge of Little Bighorn River at Crow Agency, Mont., for 1905.

[Drainage area, 1,276 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 24-31	105	105	105	1,666	0.082	0.025
April	155	80	117	6,962	.092	.103
May	470	105	235	14,450	.184	.212
June	1,740	550	977	58,140	.766	.855
July 1-3, 19-31	720	185	289	9,161	.226	.134
August	155	80	125	7,686	.098	.113
September	105	60	78	4,612	.061	.068
October	130	80	109	6,702	.085	.098
November	155	80	124	7,379	.097	.108
December			130	7,993	.102	.118
The period				124,800		

NOTE.—A gage height of 2.1 feet has been assumed as representing the normal flow during December.

SHOSHONE RIVER[a] NEAR CODY, WYO.

This station was established April 26, 1902. It is located at the wagon bridge 1 mile northeast of Cody, Wyo., in sec. 29, T. 53 N., R. 101 W.

The channel is straight both above and below the station. The banks are high and not liable to overflow. The bed of the stream is composed of gravel and rock and is fairly permanent, but occasionally a small bar, which usually remains but a short time, forms at the lower end of the center pier of the bridge. There is but one channel at all stages, interrupted by the center pier or cribbing of the bridge. The current is swift and the river bed slopes to the left bank. At low water the stream is nearly confined to a channel under the left span of the bridge, but at higher stages it rises to the abutment on the right bank.

Discharge measurements are made from the wagon bridge, the points for soundings being indicated by numbers painted on the railing. The initial point is the face of the abutment on the left bank.

The gage, which is read daily by W. J. Kissick, consists of a staff fastened to the framework of the middle pier of the bridge, downstream side. The bench mark is a bolt in the bridge sleeper 1.15 feet above the 12-foot mark on the gage; it is indicated by a cross. The range of gage heights is about 6 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 21; 99, p 83; 130, p 132.
Discharge: 84, p 22; 99, p 84; 130, p 133.
Discharge, monthly: 84, p 23; 99, p 85; 130, pp 135-136.
Gage heights: 84, p 22; 99, p 84; 130, p 134.
Rating tables: 84, p 23; 99, p 85; 130, p 134.

[a] A brief description of Shoshone River is included in the general description of the Yellowstone River basin.

Discharge measurements of Shoshone River near Cody, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 7	A. J. Parshall	128	359	1.98	2.70	710
June 4	J. Ahern	178	909	6.72	5.70	6,088
June 20	Brundage and Soper	158	647	4.69	4.20	3,034
June 26	do	185	909	7.19	5.70	6,536
June 28	do	193	965	7.82	5.95	7,550
July 8	do	168	784	6.02	5.05	4,716
July 14	A. J. Parshall	160	648	5.71	4.50	3,701
July 15	do	159	635	5.48	4.40	3,480
August 26	do	131	385	2.22	2.75	853
September 16	Brundage and Soper	123	294	1.46	2.27	432
December 1	do	90	202	1.09	1.79	223

[a] Made by wading above bridge.

Daily gage height, in feet, of Shoshone River near Cody, Wyo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	1.9	2.5	2.8	2.2	5.0	5.0	3.5	2.7	2.0	2.1	1.8
2	2.1	1.9	2.5	2.8	2.3	5.1	5.0	3.4	2.7	1.9	2.0	1.9
3	2.1	2.0	2.6	2.8	2.5	5.5	5.3	3.2	2.8	1.8	2.1	1.9
4	2.0	2.0	2.6	2.8	2.7	5.7	5.2	3.8	2.8	1.9	2.0	1.8
5	1.9	1.9	2.6	2.9	3.0	6.0	5.1	3.5	2.7	1.8	2.1	1.9
6	1.9	1.8	2.5	2.9	3.0	5.5	4.7	3.5	2.6	2.0	2.2	2.1
7	1.9	1.7	2.7	2.8	2.7	5.0	4.7	3.5	2.6	2.1	2.1	2.0
8	1.8	1.7	2.7	2.9	2.7	5.8	4.8	3.9	2.5	2.0	2.0	2.0
9	1.8	1.6	2.6	2.9	2.8	5.5	4.8	4.0	2.6	2.0	2.0	1.9
10	1.8	1.6	2.6	2.8	3.0	5.0	4.7	3.8	2.6	1.9	2.1	1.8
11	1.8	1.7	2.5	2.9	2.9	5.2	4.6	3.0	2.7	1.8	2.2	1.7
12	1.9	1.7	2.6	2.9	2.9	5.2	5.3	3.1	2.6	1.9	2.0	2.0
13	1.9	1.8	2.7	2.9	2.9	5.7	4.6	3.0	2.6	2.1	1.9	2.1
14	2.0	1.8	2.5	2.8	3.0	5.8	4.5	2.9	2.5	2.1	1.8	2.0
15	2.0	1.8	2.5	2.9	2.8	5.6	4.5	3.0	2.4	2.0	1.9	2.0
16	2.0	1.9	2.6	2.9	3.1	5.6	4.7	2.9	2.3	2.0	2.0	1.9
17	1.9	2.0	2.7	3.0	3.0	4.7	4.8	2.9	2.3	2.1	2.0	1.8
18	1.9	2.0	2.7	3.0	3.1	4.7	4.5	2.8	2.3	1.9	2.0	1.8
19	1.9	2.1	2.7	3.0	3.0	4.5	4.2	2.7	2.3	2.0	2.0	1.9
20	1.8	2.1	2.8	3.1	3.5	4.2	4.4	2.7	2.2	1.8	2.1	2.0
21	1.8	2.2	2.9	3.1	3.5	4.5	4.5	2.7	2.2	2.1	2.0	1.9
22	1.7	2.2	2.9	2.9	3.8	5.0	4.1	2.7	2.2	2.1	1.9	2.0
23	1.7	2.4	2.9	3.0	3.5	5.0	4.1	2.7	2.2	2.1	2.0	1.8
24	1.7	2.5	2.8	2.8	3.0	5.0	4.1	2.8	2.2	2.1	2.0	1.8
25	1.6	2.5	3.0	2.7	3.3	5.0	4.0	2.8	2.1	2.0	2.0	2.0
26	1.6	2.4	3.0	2.8	3.5	5.7	4.0	2.8	2.1	2.0	2.0	2.0
27	1.8	2.5	3.1	2.9	3.6	5.9	4.4	2.8	2.0	2.0	1.9	1.9
28	1.8	2.5	2.8	3.0	3.5	5.8	4.4	2.8	1.9	2.1	1.9	2.0
29	1.8	.....	2.9	2.5	4.0	5.8	4.4	2.7	1.9	1.9	1.8	2.0
30	1.9	.....	2.9	2.5	4.3	5.5	4.3	2.9	2.0	1.8	1.9	2.0
31	1.9	.....	3.0	.....	4.5	.....	3.6	3.0	.....	2.1	.....	2.0

NOTE.—The gage heights for this station as reported by the observer were greatly in error. They have been corrected and adjusted on the basis of 30 gage readings made during the year by hydrographers and by the use of the Marquette station gage heights. They are still liable to some error.

Estimated monthly discharge of Shoshone River near Cody, Wyo., for 1905.

[Drainage area, 1,480 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	365	190	270	16,600	0.182	0.210
February	630	190	351	19,490	.237	.247
March	1,230	630	833	51,220	.563	.649
April	1,230	630	972	57,840	.657	.733
May	3,705	420	1,401	86,140	.947	1.09
June	7,850	3,070	5,747	342,000	3.88	4.33
July	5,720	1,965	3,891	239,200	2.63	3.03
August	2,675	800	1,286	79,070	.869	1.00
September	900	255	559	33,260	.378	.422
October	350	220	295	18,140	.199	.229
November	410	220	303	18,030	.205	.229
December	350	190	270	16,600	.182	.210
The year	7,850	190	1,348	977,600	.911	12.38

NOTE.—The greater part of the published gage heights for December, 1904, are probably 1 foot too low, owing to inaccurate gage reading, thus causing great error in published estimates for that month. The 1905 estimates are based on two rating curves.

SOUTH FORK OF SHOSHONE RIVER AT MARQUETTE, WYO.

South Fork, which furnishes about 25 per cent of the discharge of Shoshone River, rises in the Shoshone Mountains, near the southeast corner of the Yellowstone National Park, and flows northeastward about 50 miles to the entrance of the canyon, where it joins North Fork. It receives numerous small tributaries which enter from both sides.

The gaging station was established April 26, 1903, but was discontinued during 1904. It is located at the county highway bridge at Marquette, Wyo., 12 miles west of Cody, in sec. 12, T. 52 N., R. 103 W.

The channel forms the arc of a long curve extending about 200 feet above and below the bridge. The banks do not overflow, but at highest stages the water rises a few feet against the bridge abutments on either side. The bed of the stream is rocky and stable. The river flows in a single channel under the bridge, the greatest depth being near the center. Large rocks near the left bank interfere somewhat with the accuracy of discharge measurements.

Discharge measurements are made from the bridge, sounding points being indicated by marks painted at 10-foot intervals on the lower railing. The initial point for sounding is at the abutment on the left bank.

The gage, which is read twice daily by C. P. MacGlashan, is a vertical timber set well out in the stream and fastened to a strong post placed 1 foot deep in the rocky bed of the channel and securely braced to the sleeper of the bridge. The bench mark is the lower surface of the iron plate at the bottom of the bridge stringer at the gage rod; elevation, 10.60 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 99 of the United States Geological Survey, pages 85–87.

Discharge measurements of South Fork of Shoshone River at Marquette, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 25	J. Ahern	85	88	2.16	0.70	190
May 8	A. J. Parshall	118	113	2.52	1.00	285
June 6	J. Ahern	144	275	4.61	2.40	1,269
June 15	Brundage and Saunders	144	338	5.36	2.80	1,812
June 19	Brundage and Soper	144	228	4.14	1.95	943
June 27	do	144	430	5.95	3.35	2,559
July 1	do	144	343	5.42	2.75	1,860
July 15	A. J. Parshall	144	262	5.09	2.35	1,335
September 16	Brundage and Soper	85	67	1.94	.63	130
September 19 [a]	do	72	91	1.22	.62	112

[a] Made by wading 250 feet above usual point.

Daily gage height, in feet, of South Fork of Shoshone River at Marquette, Wyo., for 1905.

Day	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.7	2.65	3.0	1.45	0.8	0.7	0.5
2	.75	2.65	2.75	1.4	.8	.7	.6
3	.85	2.8	2.45	1.35	.85	.6	.6
4	.9	3.0	2.3	1.35	.85	.6	.6
5	.85	2.9	2.45	1.25	.8	.6	.6
6	.9	2.3	2.5	1.35	.75	.6	.6
7	.95	2.3	2.7	1.3	.75	.55	.6
8	1.0	2.8	2.6	1.3	.7	.5	.6
9	.9	2.8	2.6	1.15	.75	.55	.6
10	.9	2.85	2.35	1.15	.75	.6	.55
11	.9	2.4	2.7	1.1	.8	.5	.55
12	.8	2.3	2.4	1.1	.75	.5	.6
13	.8	2.7	2.45	.95	.75	.6	.7
14	.7	2.85	2.6	.9	.65	.6	.65
15	.8	2.9	2.5	.95	.65	.55	.7
16	.75	2.7	2.45	1.05	.7	.6	.7
17	1.1	2.15	2.6	.95	.7	.6	.7
18	1.7	2.15	2.45	1.0	.65	.6	.7
19	1.4	2.0	1.8	.85	.65	.65	.7
20	1.55	2.0	2.2	.85	.6	.7	.65
21	1.65	2.1	1.95	.8	.6	.6	.7
22	1.6	2.7	1.8	.85	.6	.5	.65
23	1.65	2.3	2.65	.8	.6	.6	.65
24	1.45	2.6	2.3	.85	.6	.6	.7
25	1.45	3.05	1.7	.8	.5	.6	.6
26	1.55	3.4	2.1	.9	.5	.6	.55
27	1.5	3.8	2.5	.85	.4	.6	.5
28	1.7	3.15	2.25	.9	.5	.5	.4
29	2.3	3.0	1.8	.9	.55	.5	.35
30	2.2	2.85	1.7	.85	.6	.5	.35
31	2.55	.....	1.5	.9	.....	.5	.....

Station rating table for South Fork of Shoshone River at Marquette, Wyo., from May 1 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	63	1.30	460	2.20	1,180	3.10	2,235
.50	87	1.40	525	2.30	1,280	3.20	2,365
.60	115	1.50	590	2.40	1,385	3.30	2,500
.70	149	1.60	660	2.50	1,495	3.40	2,635
.80	189	1.70	735	2.60	1,610	3.50	2,775
.90	235	1.80	815	2.70	1,730	3.60	2,915
1.00	285	1.90	900	2.80	1,850	3.70	3,055
1.10	340	2.00	990	2.90	1,975	3.80	3,200
1.20	400	2.10	1,085	3.00	2,105		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905, and is well defined.

Estimated monthly discharge of South Fork of Shoshone River at Marquette, Wyo., for 1905.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May	1,552	149	474	29,140	0.948	1.09
June	3,200	990	1,724	102,600	3.45	3.85
July	2,105	590	1,335	82,090	2.67	3.08
August	558	189	314	19,310	.628	.724
September	212	63	143	8,509	.286	.319
October	149	87	110	6,764	.220	.254
November	149	53	117	6,962	.234	.261
The period				255,400		

PINEY CREEK AT KEARNEY, WYO.

Piney Creek rises on the eastern slope of the Bighorn Mountains, in the extreme northwestern part of Johnson County, Wyo., in the elevated plateau region east of Cloud Peak, and flows in a general northeasterly direction until it joins Clear Creek, a branch of Powder River. Its entire length is between 40 and 50 miles, and its total drainage area about 160 square miles. It receives a number of small tributaries, among which may be mentioned Little Piney Creek, which enters from the south near the gaging station at Kearney, and Boxelder Creek, which comes in a few miles above the junction of Piney and Clear creeks. Boxelder Creek probably obtains a part of its limited discharge by seepage from De Smet Lake, a small lake without outlet on the divide between this basin and that of Clear Creek to the south. The valley of Piney Creek is narrow, and is so largely composed of rock, bowlders, and cobblestones that little effort has been made to use it for agricultural purposes. The soil of the rolling uplands and side hills is a rich, deep, sandy loam, generally covered with a small growth of sagebrush and thick, luxuriant grasses. A few thousand acres, including several sidehill tracts, comprise the arable land within the Piney basin proper to which the water supply has been applied. Two large ditches, taken out at the point where the creek leaves the mountain slopes to enter the valley, have been carried from Piney Creek across the low divide to the Prairie Dog basin, where the soil conditions are similar. Near the

head of Piney Creek are several small lakes, at one of which—Piney Lake—an earthen dam was constructed some years ago to conserve waters for use on the northern slope of the northern Piney divide. This dam, which was not well planned or constructed, gave way when nearly filled and caused considerable destruction to properties below.

The gaging station was established September 6, 1902. It is located at the highway bridge about 100 yards south of the Kearney post-office, at the crossing of the stage road from Buffalo to Sheridan, on the water front of the Geier ranch. This ranch is one of the most productive properties on Piney Creek and is built on the site of old Fort Kearney.

The channel is straight for 600 feet above and below the station. The right bank is high and does not overflow; the left bank overflows at extreme flood stages, when a slough about 100 yards from the bank carries a small amount of water. The bed of the stream is composed of gravel. There is but one channel. The current is very swift during high water and sluggish at low-water periods. There are no obstructions in the channel, either above or below.

Discharge measurements are made from the bridge. The initial point is a zero painted on the floor of the bridge at the right bank.

The gage is read once daily at ordinary stages and twice daily during times of greatest fluctuations, by A. J. Sinsel, who lives one-fourth mile distant. The gage is a vertical staff, spiked to the lower abutment of the bridge on the right bank. The bench mark is the United States Geological Survey bench at Geier's ranch, about 60 feet south of the gage; it is marked "Sher. 4662," and its elevation is 4,661.77 feet above sea level. The elevation of the zero of the gage is 4,645.96 feet; the range of gage heights is about 2.5 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 21; 99, p 77; 130, p 138.
Discharge: 84, p 21; 99, pp 77-78; 130, p 139.
Discharge, monthly: 99, p 79; 130, p 140.
Gage heights: 84, p 21; 99, p 78; 130, p 139.
Rating table: 99, p 79; 130, p 140.

Discharge measurements of Piney Creek at Kearney, Wyo., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 15	A. J. Parshall	40	57	0.54	1.40	31
May 10	do	41	81	1.32	2.00	107
May 11	do	41	80	1.18	1.92	94
June 5	do	42	137	7.33	3.40	1,004
June 6 [a]	do	42	95	5.36	2.80	509
July 6	do	41	89	1.66	1.95	148
July 6	do	41	91	1.46	1.90	133
July 7	do	41	88	1.39	1.85	122
July 18	do	40	80	1.21	1.70	97
August 24	do	40	62	.82	1.40	52
September 30	do	40	53	.45	1.10	24

[a] Measured above bridge.

Daily gage height, in feet, of Piney Creek at Kearney, Wyo., for 1905.

Day	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.4	1.8	2.88	2.35	1.6	1.25	1.15	1.4
2	1.4	1.9	3.1	2.3	1.6	1.25	1.2	1.4
3	1.4	1.8	3.3	2.3	1.55	1.2	1.15	1.4
4	1.4	1.7	3.7	2.2	1.4	1.2	1.15	1.4
5	1.4	1.7	3.5	2.15	1.2	1.2	1.15	1.4
6	1.45	1.8	2.78	2.05	1.2	1.2	1.15	1.4
7	1.45	1.85	2.88	1.9	1.2	1.2	1.15	1.4
8	1.5	1.85	3.25	1.9	1.1	1.2	1.15	1.4
9	1.5	1.9	3.25	1.9	1.1	1.2	1.15	1.4
10	1.5	1.9	2.88	1.9	1.1	1.15	1.1	1.35
11	1.5	1.95	2.75	1.9	1.2	1.15	1.1	1.35
12	1.5	2.0	2.72	1.9	1.3	1.15	1.1	1.35
13	1.55	1.95	2.82	1.9	1.3	1.15	1.1	1.35
14	1.55	1.95	2.75	1.9	1.2	1.15	1.1	1.35
15	1.55	2.0	2.68	2.1	1.2	1.15	1.15	1.35
16	1.5	2.0	2.62	2.0	1.2	1.15	1.15	1.35
17	1.5	2.1	2.45	1.95	1.2	1.15	1.15	1.35
18	1.5	2.2	2.35	1.8	1.2	1.15	1.15	1.35
19	1.5	2.3	2.30	1.7	1.2	1.15	1.15	1.3
20	1.5	2.2	2.35	1.9	1.2	1.15	1.2	1.3
21	1.5	2.3	2.38	1.85	1.3	1.15	1.25	1.3
22	1.5	2.35	2.38	1.75	1.3	1.2	1.3	1.3
23	1.5	2.75	2,38	1.7	1.4	1.2	1.35	1.3
24	1.55	2.55	2.3	1.7	1.45	1.15	1.4	1.3
25	1.6	2.5	2.3	1.7	1.4	1.15	1.4	1.3
26	1.7	2.5	2.42	1.7	1.4	1.15	1.45	1.3
27	1.85	2.45	2.45	1.8	1.3	1.15	1.4	1.3
28	1.75	2.5	2.45	1.75	1.3	1.15	1.4	1.3
29	1.7	2.65	2.25	1.65	1.3	1.15	1.4	1.3
30	1.75	2.75	2.3	1.65	1.3	1.15	1.4	1.3
31	.....	2.85	.....	1.6	1.25	.....	1.4	.....

Station rating table for Piney Creek at Kearney, Wyo., from January 1, 1904, to June 5, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	15	1.80	76	2.40	262	3.00	660
1.30	21	1.90	96	2.50	310	3.10	750
1.40	29	2.00	118	2.60	364	3.20	850
1.50	38	2.10	144	2.70	430	3.30	960
1.60	48	2.20	178	2.80	500	3.40	1,080
1.70	60	2.30	218	2.90	580	3.50	1,200

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904, and is well defined between gage heights 1.3 feet and 3 feet.

Station rating table for Piney Creek at Kearney, Wyo., from June 6 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	24	1.70	94	2.30	262	2.90	595
1.20	32	1.80	113	2.40	302	3.00	675
1.30	41	1.90	136	2.50	347	3.10	765
1.40	52	2.00	162	2.60	400	3.20	860
1.50	64	2.10	192	2.70	460	3.30	960
1.60	78	2.20	225	2.80	525		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made subsequent to June 5, 1905. It is well defined between gage heights 1.1 feet and 2 feet.

Estimated monthly discharge of Piney Creek at Kearney, Wyo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	86	29	42.2	2,511
May	540	60	196	12,050
June	1,450	244	510	30,350
July	282	78	142	8,731
August	78	24	41.3	2,539
September	36	28	29.7	1,767
October	58	24	35.3	2,170
November	52	41	45.8	2,725
The period				62,840

MISCELLANEOUS MEASUREMENT.

A measurement of Clark Fork at Bridger, Mont., made June 1, 1905, gave the following: Area of section, 755 square feet; mean velocity, 5.42 feet per second; discharge, 4,088 second-feet.

LITTLE MISSOURI RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Little Missouri rises in the central part of Crook County, in northeastern Wyoming, flows northeastward, crossing the southeast corner of Montana and the northwest corner of South Dakota, and empties into the Missouri in North Dakota, in the Fort Berthold Indian Reservation. The upper portion of the basin is mountainous, but the stream flows for the most part through a rolling country bounded in places by ranges of steep hills carrying some timber. The soil is partly a sandy loam and partly gumbo, and there is little land under cultivation. The stream receives numerous small tributaries, most of which are dry for the greater part of the year. The main floods occur during March, May, June, and July. During the rainy season some water is diverted from the tributaries and a small quantity is stored for irrigation.

LITTLE MISSOURI RIVER AT ALZADA, MONT.

This station was established April 3, 1904. It is located at the highway bridge on the old Spearfish and Miles City stage road, about one-half mile northwest of Alzada, Mont.

The channel is straight both above and below the station for about 200 feet. Both banks are high, but are liable to overflow at extreme high water. The bed of the stream is composed of fine silt and is fairly permanent. The current is moderately swift, except at low

water. There is but one channel, broken by the middle crib pier of the bridge. This pier and the ice breaker just above are the only obstructions in the channel at the station. Willows and brush on the banks tend to retard the flow during high water. Below the station the willows grow in some places so that their branches reach nearly across the channel. The stream is frozen from about December 20 to March 10, and observations are discontinued during that time.

Discharge measurements are made at high stages from the downstream side of the bridge. The initial point for soundings is a bolt in the downstream hand rail near the left end of the bridge. Low-water measurements are made by wading one-half mile above the gage.

The gage, which was read during 1905 once each day by Miss Elsie King, consists of a plain staff attached vertically to the downstream side of the crib pier supporting the middle of the bridge. The gage is referred to bench marks as follows: (1) A spike driven into the base of a tree about 50 feet west of the left end of the bridge; elevation above the zero of the gage, 16.33 feet. (2) A United States Geological Survey standard bench mark in front of the Alzada post-office, about 2,000 feet distant; elevation above sea level, 3,428 feet, and above the zero of the gage, 26.82 feet. The elevation of the gage zero above sea level is 3,401.18 feet.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 140 to 143.

Discharge measurements of Little Missouri River at Alzada, Mont., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 21	H. D. Comstock	6	1.5	1.0	1.10	1.5
June 7	do	6	2.1	2.14	1.24	4.5
July 24	do	21	13.0	2.29	1.90	3.0
August 24	do				1.10	3.0

Daily gage height, in feet, of Little Missouri River at Alzada, Mont., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.6	1.2	1.1	1.4	2.2	1.5	5.3	1.0
2	.....	1.6	1.5	1.1	3.6	1.9	2.8	4.0	1.0
3	.....	1.5	4.4	2.0	13.0	1.2	2.2	3.3	1.0
4	.....	1.5	11.4	2.0	13.1	1.0	1.8	2.3	1.0
5	.....	1.1	12.6	1.8	3.8	2.0	1.4	1.4	1.0
6	.....	1.1	9.95	1.4	3.7	1.2	1.2	1.2	1.0
7	.....	1.1	4.6	1.2	3.4	1.2	1.2	1.1	1.0
8	.....	1.1	2.9	1.2	3.2	1.2	1.2	1.0	1.0
9	.....	1.1	1.6	3.0	2.7	1.2	1.2	1.0	1.0
10	.....	1.1	1.6	2.2	2.6	1.2	1.2	1.0	1.0
11	.....	1.1	1.6	1.5	2.5	1.2	1.2	1.0	1.0
12	.....	1.1	1.5	1.3	2.4	3.0	1.2	1.0	1.0
13	.....	1.1	1.3	1.2	2.3	6.0	1.2	1.0	1.0
14	.....	1.1	1.3	1.1	3.0	4.0	1.0	1.0	1.0
15	1.4	1.1	1.3	8.5	3.5	2.0	1.0	1.0	1.0
16	1.4	1.4	1.2	3.0	2.2	1.5	1.0	1.0	1.0
17	1.4	1.4	1.2	9.7	4.0	1.2	1.0	1.0	1.0
18	1.4	1.4	1.1	14.0	3.2	1.2	1.0	1.0	1.0
19	1.4	1.3	1.1	12.6	2.0	1.2	1.0	1.0	1.0
20	1.4	1.2	1.2	11.5	7.0	1.2	1.0	1.0	1.0
21	1.4	1.2	1.2	4.0	6.5	1.0	1.0	1.0	1.0
22	1.4	1.2	1.2	2.2	4.5	1.0	1.0	1.4	1.0
23	1.4	1.2	1.3	2.5	3.0	1.0	1.0	3.8	1.0
24	1.4	1.2	1.1	2.7	2.0	1.0	1.0	2.4	1.0
25	1.4	1.2	1.1	3.0	3.0	1.0	1.0	1.2	1.0
26	1.4	1.2	1.2	3.2	4.3	1.0	1.0	1.2	1.0
27	1.4	1.2	1.2	2.0	5.0	1.0	1.0	1.0	1.0
28	1.7	1.2	1.1	1.6	4.0	1.2	1.0	1.0	1.0
29	1.7	1.2	1.1	1.5	7.0	1.0	1.0	1.0	1.0
30	1.7	1.2	1.1	1.4	3.9	1.0	6.0	1.0	1.0
31	1.7	.....	1.1	.....	2.6	10.0	.....	1.0	.....

Station rating table for Little Missouri River at Alzada, Mont., from March 15, to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1	2.30	67	3.60	178	4.90	300
1.10	2	2.40	75	3.70	187	5.00	310
1.20	4	2.50	83	3.80	196	5.10	320
1.30	7	2.60	91	3.90	205	5.20	330
1.40	10	2.70	99	4.00	214	5.30	340
1.50	14	2.80	107	4.10	223	5.40	350
1.60	19	2.90	115	4.20	232	5.50	360
1.70	24	3.00	124	4.30	241	5.60	370
1.80	30	3.10	133	4.40	250	5.70	380
1.90	37	3.20	142	4.50	260	5.80	390
2.00	44	3.30	151	4.60	270	5.90	400
2.10	51	3.40	160	4.70	280	6.00	411
2.20	59	3.50	169	4.80	290		

The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904-5, and is well defined between gage heights 1 foot and 6 feet. Above 3 feet the table is the same as that for 1904. Above 6 feet the discharge is only approximate.

Estimated monthly discharge of Little Missouri River at Alzada, Mont., for 1905.

[Drainage area, 600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 15-31	24	10	13.3	449	0.022	0.014
April	19	2	5.6	333	.0093	.010
May	1,173	2	124	7,624	.207	.239
June	1,354	2	212	12,620	.353	.394
July	1,237	10	245	15,060	.408	.470
August	861	1	60.2	3,702	.100	.115
September	411	1	22.6	1,345	.038	.042
October	340	1	35.4	2,177	.059	.068
November	1	1	1.0	60	.0017	.0019
The period				43,370		

LITTLE MISSOURI RIVER AT CAMP CROOK, S. DAK.

This station was established September 2, 1903. It is located near the old highway bridge on the road from Camp Crook to Belle Fourche, about one-half mile from Camp Crook, in T. 18 N., R. 1 E.

The channel is straight for 300 feet above and 400 feet below the station. Both banks are sparsely wooded, and the left bank overflows at high water. The bed is sandy and somewhat shifting. There is but one channel at all stages. The current is sluggish at low water. The river is frozen from about December 20 to March 10, and observations are discontinued during that time. Gage heights range from zero to 10 feet.

High-water measurements are made from a car and cable 200 feet above the old bridge. The cable is marked at 10-foot intervals with white paint. The initial point for soundings is the left cable support. Low-water measurements are made by wading near the cable. The gage was read once each day during 1905 by Paul A. Chuning. The original gage was destroyed by floods in the spring of 1904. The present temporary gage, established April 20, 1905, consists of three parts—a staff driven in the center of the channel, a staff driven on the left bank, and a timber spiked to the left abutment of the old bridge. This gage will be replaced by a permanent gage on the steel bridge now being erected. The gage is referred to bench marks as follows: (1) A spike driven in a blaze 6 inches above ground on a tree near the road, 100 feet from the right end of the bridge; elevation, 10.53 feet above the zero of the gage. (2) A spike driven in a blaze 6 inches above ground on a tree across the road from bench mark No. 1 and 175 feet farther downstream; elevation above the zero of the gage, 12.89 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 73; 130, pp 143-144.
Discharge: 99, p 74; 130, p 144.
Discharge, monthly: 130, p 146.
Gage heights: 99, p 74; 130, p 145.
Rating table: 130, p 145.

Discharge measurements of Little Missouri River at Camp Crook, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 20	H. D. Comstock	64	24	1.00	0.45	24
June 4	do	28	17	.61	.34	10.3
June 6	do	21	5.5	1.42	.31	7.8
July 25	do	114	197	2.12	2.15	418
July 26	do	110	166	1.77	1.90	294
August 23	Stevens and Comstock	68	48	1.10	.69	53

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Little Missouri River at Camp Crook, S. Dak., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		0.3	0.4	1.1	4.0	5.0	0.4	0.9
2		.3	.4	3.2	3.5	5.6	3.7	.8
3		.3	.4	5.85	2.7	3.0	2.9	.7
4		1.1	.4	6.7	1.9	2.25	2.7	.7
5		3.0	.4	6.0	1.7	2.0	2.6	.6
6		4.0	.4	5.1	1.7	1.8	2.4	.6
7		4.0	.3	2.2	1.6	1.7	1.7	.6
8		2.6	.3	1.9	1.4	1.7	1.2	.5
9		1.6	.4	1.8	1.2	1.7	.7	.5
10		1.3	.4	2.0	1.0	.7	.5	.5
11		1.3	.4	2.0	.9	.6	.5	.5
12		.9	.5	2.0	.8	.5	.5	.5
13		.8	.9	1.8	.7	.5	.5	.4
14		.8	.85	1.8	.7	.5	.5	.4
15		.6	.8	1.4	2.0	.5	.5	.4
16		.55	4.9	2.0	2.1	.5	.5	.4
17		.5	5.6	6.8	1.7	.5	.5	.4
18		.5	7.0	5.1	1.0	.5	.5	.4
19		.5	7.6	3.0	.9	.4	.7	.4
20	0.45	.5	5.6	2.4	.7	.4	.7	.4
21	.5	.5	4.5	1.5	.7	.3	.9	.4
22	.5	.5	3.3	1.6	.7	.3	1.0	.5
23	.4	.4	2.5	2.6	.6	.3	1.5	.5
24	.4	.4	1.6	2.6	.6	.3	1.6	.5
25	.4	.3	1.4	2.1	.6	.3	1.9	.5
26	.35	.3	1.8	1.7	.6	.3	2.5	.5
27	.3	.4	1.7	.8	.6	.3	1.9	.4
28	.3	.4	1.7	1.8	.6	.3	1.8	.4
29	.3	.4	1.6	4.2	.5	.3	1.5	.4
30	.3	.4	1.5	6.0	.5	.4	1.4	.4
31		.4		6.15	.5		1.0	

Station rating table for Little Missouri River at Camp Crook, S. Dak., from April to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	3	1.00	93	1.70	270	2.40	523
.30	7	1.10	111	1.80	302	2.50	565
.40	16	1.20	132	1.90	335	2.60	608
.50	26	1.30	156	2.00	370	2.70	652
.60	37	1.40	182	2.10	406	2.80	697
.70	49	1.50	210	2.20	444	2.90	743
.80	62	1.60	239	2.30	483	3.00	790
.90	77						

The above table is applicable only for open-channel conditions. It is based on sixteen discharge measurements made during 1903–1905, and is well defined between gage heights 0.3 foot and 2.6 feet. The discharge above 3 feet is only approximate.

Estimated monthly discharge of Little Missouri River at Camp Crook, S. Dak., for 1905.

[Drainage area, 1,900 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 20–30	26	7	14.6	319	0.0077	0.0032
May	1,320	7	170	10,450	.089	.103
June	3,480	7	608	36,180	.320	.357
July	3,000	62	961	59,090	.506	.583
August	1,320	26	208	12,790	.109	.126
September	2,280	7	244	14,520	.128	.143
October	1,147	16	229	14,080	.121	.140
November	77	16	27.2	1,618	.014	.016
The period				149,000		

LITTLE MISSOURI RIVER AT MEDORA, N. DAK.

This station was established May 12, 1903. It is located at the Northern Pacific Railway bridge, one-third mile west of the railroad station at Medora, N. Dak.

The channel is straight for 100 feet above the station and 300 feet below. The right bank is clean, low, and overflows at very high stages; the left bank is almost perpendicular and has a height of 30 feet above gage datum. The bed of the stream is of clay and sand, and sometimes scours from 5 to 8 feet during floods; at ordinary stages the bed changes only slightly. There is but one channel, broken by three piers, according to the stage of the river. In the latter part of 1903 the cross section at the bridge was temporarily changed during repairs to the bridge by the railroad company, continuing several months.

Discharge measurements are made from the railroad bridge to which the gage is attached. The initial point for soundings is the left end of the guard rail on the lower side of the bridge, 2.9 feet west of the east face of the concrete abutment.

The gage was read during 1905 by W. A. Brubaker and P. E. Anderson. A standard chain gage is located on the lower side of the railroad bridge at a point 91 feet from the initial point for soundings. There is also a vertical board gage reading from 1 foot to 9 feet, fastened to a pile in the river about 200 feet above the bridge. August 7, 1905, on account of the bridge having been changed by the railroad, a chain length of 30.92 feet was

established, which made the readings agree with the timber gage. The bench mark is the top of the southwest corner of the concrete abutment on the left bank; elevation above gage datum, 30.11 feet. The top of the gage pulley is 31.6 feet above the gage datum, which is about 2,230 feet above sea level, as determined by hand level from the railroad station at Medora, N. Dak.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 70-71; 130, pp 146-147.
Discharge: 99, p 71; 130, p 147.
Discharge, monthly: 99, p 73; 130, p 149.
Gage heights: 99, pp 71-72; 130, pp 147-148.
Rating table: 99, p 72; 130, p 148.

Discharge measurements of Little Missouri River at Medora, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 26	E. F. Chandler	59	130	.95	3.60	123
July 7	Chandler and Richards	183	1,026	4.19	8.45	4,302
July 8	do	180	959	4.73	8.08	4,539
Do	E. F. Chandler	180	966	4.27	8.13	4,124
Do	R. Richards	181	975	4.30	8.18	4,195
August 6	do	143	456	2.75	5.96	1,256
August 7	do	135	398	2.61	5.61	1,038
August 24	do	88	173	1.55	4.01	269
October 16	do	74	186	.87	3.72	161

Daily gage height, in feet, of Little Missouri River at Medora, N. Dak., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	7.2	3.3	2.6	3.2	9.8	5.8	3.5	4.0	3.6
2	.....	7.0	3.2	2.6	3.2	10.2	5.6	3.5	4.0	5.1
3	.....	6.5	3.2	2.6	3.1	9.8	6.8	3.4	4.0	5.0
4	.....	6.5	3.2	2.6	8.7	7.6	7.2	3.4	4.0	4.8
5	.....	6.3	3.2	2.6	9.4	8.8	7.3	3.4	4.0	5.0
6	.....	5.4	3.2	2.6	8.5	9.2	6.4	6.0	5.0	4.9
7	.....	4.2	3.2	2.6	9.3	8.6	5.1	5.6	5.0	4.7
8	.....	4.1	3.2	2.6	8.2	8.2	6.0	5.0	5.0	4.4
9	.....	4.0	3.1	2.8	7.3	7.9	6.1	4.7	4.9	4.2
10	.....	4.0	3.1	2.9	6.1	7.4	5.9	4.5	4.8	4.0
11	.....	4.0	3.0	3.5	6.0	7.2	5.5	4.3	4.6	3.8
12	.....	4.0	3.0	3.5	5.8	7.2	5.1	4.1	4.4	3.6
13	.....	4.0	3.0	3.8	5.2	6.7	4.9	4.0	4.2	3.6
14	.....	4.0	3.0	3.8	6.3	6.0	4.3	4.0	4.0	3.5
15	.....	3.9	3.0	3.7	5.8	5.3	4.0	4.0	4.0	3.5
16	.....	3.9	2.9	3.6	6.4	5.0	3.8	3.8	4.0	3.5
17	.....	3.9	2.9	3.6	5.4	4.7	4.0	3.6	3.9	3.5
18	.....	3.9	2.9	3.6	5.1	4.5	4.2	3.4	3.8	3.5
19	.....	3.8	2.9	3.6	4.6	5.2	4.0	3.4	3.8	3.4
20	.....	3.8	2.8	3.6	6.6	8.8	3.8	3.2	3.7	3.4
21	.....	3.8	2.8	3.6	7.8	8.5	3.7	3.0	3.6	3.4
22	.....	3.7	2.8	3.5	7.9	8.3	3.7	3.0	3.6	3.4
23	.....	3.6	2.7	3.5	9.2	8.8	3.7	2.8	3.6	3.4
24	.....	3.6	2.7	3.5	8.2	9.0	3.7	2.8	3.5	3.4
25	3.0	3.6	2.6	3.4	8.6	7.9	3.7	2.6	3.4	3.4
26	3.3	3.5	2.6	3.3	7.0	7.3	3.7	2.6	3.6	3.4
27	4.5	3.5	2.6	3.3	6.8	7.2	3.6	2.5	3.4	3.4
28	4.9	3.5	2.6	3.3	6.6	7.0	3.6	2.4	3.4	3.4
29	.....	3.4	2.6	3.2	6.5	7.7	3.6	4.5	3.4	.....
30	.....	3.4	2.6	3.2	6.3	6.1	3.5	4.0	3.3	.....
31	.....	3.3	.....	3.2	.....	6.1	3.5	.....	3.3	.....

NOTE.—River frozen January 1 to February 28, during part of the time frozen to bottom in places, the discharge being very small. Also frozen November 28 to December 31.

Station rating table for Little Missouri River at Medora, N. Dak., from February 28 to November 28, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	1.9	3.90	223	5.30	870	7.40	2,405
2.50	2.2	4.00	260	5.40	925	7.60	2,600
2.60	2.7	4.10	298	5.50	980	7.80	2,805
2.70	3.3	4.20	338	5.60	1,035	8.00	3,015
2.80	4.1	4.30	380	5.70	1,095	8.20	3,230
2.90	5.2	4.40	424	5.80	1,155	8.40	3,450
3.00	6.8	4.50	470	5.90	1,215	8.60	3,675
3.10	9.8	4.60	520	6.00	1,280	8.80	3,905
3.20	15	4.70	570	6.20	1,410	9.00	4,140
3.30	29	4.80	620	6.40	1,555	9.20	4,380
3.40	54	4.90	670	6.60	1,710	9.40	4,620
3.50	85	5.00	720	6.80	1,870	9.60	4,860
3.60	118	5.10	770	7.00	2,040	9.80	5,100
3.70	152	5.20	820	7.20	2,220	10.00	5,340
3.80	187						

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5, and is well defined between gage heights 3.2 feet and 6 feet. It has been extended beyond these limits, being based on three high-water measurements near 8 feet gage height. Above 6 feet the table can be considered as only approximate.

Estimated monthly discharge of Little Missouri River at Medora, N. Dak., for 1905.[a]

[Drainage area, 5,785[a] square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	2,220	29	467	28,720	0.081	0.093
April	29	2.7	8.1	483	.0014	.0016
May	187	2.7	60.5	3,720	.010	.012
June	4,620	9.8	2,016	120,000	.349	.389
July	5,580	470	2,696	165,800	.467	.538
August	3,905	85	781	48,020	.135	.157
September	1,280	1.9	235	13,980	.041	.046
October	720	29	271	16,660	.047	.054
November 1-28	770	54	236	13,110	.041	.043
The period				410,500		

[a] Revised since 1904 report.

KNIFE RIVER DRAINAGE BASIN.

KNIFE RIVER AT BRONCHO, N. DAK.

Knife River rises in the northeastern part of Billings County, N. Dak., flows southeastward, then northeastward, and unites with the Missouri near Stanton, Mercer County, N. Dak.

The gaging station was established May 29, 1903. Its first location was at a point about 600 feet east of H. M. Haven's ranch house, where the Broncho post-office was situated at that time, and about 23 miles north of Hebron, N. Dak., on the Northern Pacific Railway. Owing to the abandonment of the Haven ranch and the removal of the post-office to the

house of F. M. Smith, in the SE. ¼ sec. 4, T. 142, R. 90 W., about 3 miles up the valley, the location was abandoned and a new station was established at the ranch of Mr. Smith. As no streams enter the river between the two points the run-off will be practically identical.

The channel is straight for 150 feet above the station and 400 feet below. Both banks are high and grassy and not subject to overflow. The bed of the stream is composed of firm clay and silt and may scour a little, but does not shift. The current at the cable is sluggish except at high stages.

Discharge measurements are made by means of a cable and car. The initial point for soundings is at the cable support on the right bank. Distances from the initial point are determined by a tagged line of heavy telegraph wires. Low-water measurements are made by wading a few rods below the gage.

The gage, which was read during 1905 by Sara J. Smith, is of the standard chain type, mounted on a projecting timber extending horizontally out over the water and substantially braced and guyed. The length of the chain is 32.65 feet. The distance from the center of the gage pulley to the zero of the scale is 11.7 feet, and the diameter of the pulley is 0.22 foot. The elevation of the center of the pulley, referred to the gage datum, is 20.86 feet, while that of the horizontal gage scale timber at the shore end is 21.03 feet. Supplementary to the chain gage are two rod gages driven into the left bank about 75 feet downstream from the chain gage, consisting of timbers braced to posts in the bank. The lower section reads from 2.6 to 9 feet; the upper reads from 9 to 13.9 feet. The chain gage is referred to bench marks as follows: (1) A cross on the top of a gray granite bowlder 1 foot in diameter, set flush with the ground in the line of the gage timber prolonged 5 feet behind the inner end of same; elevation above the zero of the gage, 21.15 feet. (2) A horizontal line of five nails driven into a joint of the stone foundation of the observer's house, 3 inches from the southeast corner; elevation above the gage datum, 31.25 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 68; 130, pp 149-150.
Discharge: 99, p 69; 130, p 150.
Discharge, monthly: 99, p 70.
Gage heights: 99, p 69; 130, p 150.
Rating table: 99, p 70.

Discharge measurements of Knife River at Broncho, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 23	E. F. Chandler	10	8.6	2.12	3.89	18
July 3	Chandler and Richards	10	8.4	1.16	3.60	9.8
July 5	do	52	261	2.42	7.51	632
July 5	do	47	233	2.09	6.92	486
August 5	R. Richards	32	40	1.09	4.05	44
August 26	do	11	2.9	.70	3.35	2
October 17	do	9	6.3	.50	3.37	3.1

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Knife River at Broncho, N. Dak., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.7	3.4	3.5	3.6	3.35	3.2	3.45	3.3
2	.....	3.7	3.4	3.45	3.6	3.4	3.2	3.3	3.3
3	.....	3.65	3.4	3.4	3.6	5.8	3.2	3.35	3.4
4	.....	3.65	3.42	3.8	3.6	4.2	3.2	3.4	3.4
5	.....	3.6	3.6	6.1	7.2	3.95	3.15	3.3	3.4
6	.....	3.6	3.6	4.4	6.5	3.65	3.1	3.4	3.4
7	.....	3.6	3.6	7.4	4.8	3.6	3.1	3.3	3.4
8	.....	3.6	3.6	6.5	4.4	3.6	3.1	3.3	3.4
9	.....	3.55	3.6	6.0	4.2	3.5	3.2	3.3	3.45
10	.....	3.55	3.8	4.65	4.1	3.45	3.2	3.3	3.45
11	.....	3.55	3.7	4.3	3.9	3.45	3.2	3.3	3.4
12	.....	3.52	3.9	4.15	3.95	3.45	3.2	3.3	3.4
13	.....	3.5	3.8	4.1	3.9	3.4	3.2	3.3	3.4
14	.....	3.5	3.8	3.9	3.85	3.5	3.3	3.3	3.4
15	.....	3.5	3.8	3.9	3.7	3.5	3.25	3.3	3.5
16	.....	3.5	3.7	3.9	3.9	3.5	3.25	3.35	3.4
17	.....	3.5	3.7	3.9	5.0	3.5	3.2	3.35	3.4
18	.....	3.5	3.65	4.1	4.4	3.45	3.2	3.35	3.4
19	.....	3.5	3.6	4.1	4.0	3.45	3.3	3.35	3.4
20	.....	3.45	3.6	4.0	3.9	3.4	3.4	3.3	3.4
21	.....	3.45	3.55	4.05	3.8	3.4	3.3	3.3	3.4
22	.....	3.4	3.5	4.15	3.8	3.3	3.2	3.3	3.4
23	3.9	3.4	3.5	4.0	3.6	3.3	3.4	3.3	3.4
24	3.8	3.4	3.55	3.9	3.6	3.3	3.2	3.3	3.4
25	3.9	3.4	3.5	3.8	3.53	3.3	3.3	3.3	3.4
26	3.8	3.4	3.45	3.7	3.5	3.25	3.25	3.3	3.4
27	3.8	3.4	3.45	3.7	3.5	3.25	3.25	3.3	.....
28	3.75	3.4	3.4	3.7	3.5	3.25	3.25	3.3	.....
29	3.7	3.4	3.5	3.6	3.45	3.25	3.25	3.3	.....
30	3.7	3.4	3.55	3.6	3.45	3.2	3.4	3.3	.....
31	3.7	.....	3.65	.....	3.4	3.2	.....	3.3	.....

NOTE.—River frozen over November 27.

HEART RIVER DRAINAGE BASIN.

HEART RIVER NEAR RICHARDTON, N. DAK.

Heart River rises in eastern Billings County, N. Dak., flows eastward and southeastward for about 100 miles by general course, then turns abruptly to the north and northeast and enters the Missouri near Bismarck, N. Dak.

The gaging station was established May 18, 1903. It is located at the iron highway bridge 10 miles south of the Northern Pacific Railway station at Richardton, N. Dak.

The channel is straight for 150 feet above and below the station. Both banks are high and covered with brush. The bed of the stream is sandy and shifting. The velocity of the current is moderate.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the end of the guard rail on the lower side of the bridge, at the left bank.

A standard chain gage, which was read once each day during 1905 by W. F. Church, is located on the lower side of the bridge. The length of the chain is 24.34 feet. The gage is referred to bench marks as follows: (1) The top of the foot-guard rail at a distance of 45 feet from the initial point for soundings; elevation above gage datum, 25.58 feet. (2) On top of the iron flanges around the top of the downstream eastern edge of the concrete iron pier on the lower side of the bridge, on the left bank; elevation above gage datum, 24.79 feet.

The top of the gage pulley has the same elevation as bench mark No. 1. Gage datum is 2,150 feet above sea level, as determined by carrying an aneroid barometer six times between this point and the railroad station at Richardton.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 66; 130, p 151.
Discharge: 99, p 66; 130, p 151.
Discharge, monthly: 99, p 68; 130, p 153.
Gage heights: 99, p 67; 130, p 152.
Rating table: 99, p 67; 130, p 152.

Discharge measurements of Heart River near Richardton, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height	Dis-charge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 25	E. F. Chandler	36	24	0.70	4.64	17
July 7	do	66	203	1.60	6.88	325
August 8	R. Richards	15.5	6.6	.75	4.24	5.0
August 24	do	4.6	1.3	.64	4.00	.9
October 16	do	7.0	4.5	.64	4.14	2.9

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Heart River near Richardton, N. Dak., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.6	4.5	4.1	4.2	4.4	4.3	3.8	4.1	4.2
2	7.25	4.5	4.1	4.2	4.4	4.3	3.8	4.1	4.2
3	6.8	4.5	4.1	4.2	4.4	4.3	3.8	4.1	4.2
4	6.1	4.4	4.2	4.2	4.4	4.3	3.8	3.9	4.2
5	6.1	4.4	4.3	6.7	9.1	4.3	3.8	3.9	4.2
6	6.1	4.4	4.3	5.4	9.1	4.3	3.8	3.9	4.2
7	5.6	4.3	4.3	5.1	7.4	4.3	3.8	3.9	4.3
8	5.5	4.3	4.3	5.5	6.2	4.2	3.8	3.9	4.3
9	5.5	4.3	4.3	5.7	5.6	4.2	3.8	4.2	4.3
10	5.5	4.3	4.4	5.1	5.3	4.2	3.8	4.3	4.3
11	5.5	4.3	4.4	4.9	5.1	4.2	3.8	4.3	4.3
12	5.4	4.3	4.4	4.9	5.0	4.2	3.8	4.2	4.3
13	5.1	4.3	4.3	4.7	4.9	4.2	3.8	4.2	4.3
14	5.0	4.3	4.3	4.6	4.8	4.2	3.8	4.1	4.3
15	4.9	4.3	4.3	4.6	5.55	4.2	3.8	4.1	4.3
16	4.9	4.3	4.3	4.5	7.05	4.2	3.8	4.1	4.3
17	4.8	4.2	4.3	4.5	6.6	4.1	3.8	4.0	4.3
18	4.8	4.2	4.3	4.6	6.0	4.1	3.8	4.0	4.3
19	4.8	4.2	4.3	4.7	5.7	4.1	3.8	4.0	4.3
20	4.8	4.2	4.3	4.7	5.0	4.1	4.5	4.0	4.4
21	4.7	4.2	4.3	4.6	5.1	4.1	4.5	4.0	4.4
22	4.7	4.2	4.3	4.6	4.6	4.0	4.4	4.0	4.4
23	4.7	4.2	4.3	4.7	4.6	4.0	4.3	4.0	4.4
24	4.6	4.2	4.3	4.8	4.6	4.0	4.3	4.0	.....
25	4.6	4.2	4.3	4.7	4.5	4.0	4.3	4.1	.....
26	4.6	4.2	4.3	4.7	4.5	4.0	4.2	4.1	.....
27	4.6	4.2	4.3	4.6	4.5	4.0	4.2	4.1	.....
28	4.6	4.1	4.2	4.5	4.4	4.0	4.1	4.1	.....
29	4.5	4.1	4.2	4.5	4.4	3.9	4.1	4.2	.....
30	4.5	4.1	4.2	4.4	4.4	3.9	4.1	4.2	.....
31	4.5	.....	4.2	.....	4.4	3.9	.....	4.2	.....

NOTE.—River frozen January 1 to February 26 and November 24 to December 31.

Station rating table for Heart River near Richardton, N. Dak., from March 1 to November 23, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
3.90	0.5	5.00	42	6.10	187	7.40	430
4.00	1	5.10	51	6.20	204	7.60	471
4.10	2	5.20	61	6.30	221	7.80	513
4.20	4	5.30	72	6.40	238	8.00	556
4.30	6	5.40	84	6.50	256	8.20	600
4.40	9	5.50	97	2.60	274	8.40	645
4.50	12	5.60	110	6.70	292	8.60	692
4.60	16	5.70	124	6.80	310	8.80	740
4.70	21	5.80	139	6.90	330	9.00	788
4.80	27	5.90	155	7.00	350		
4.90	34	6.00	171	7.20	390		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 and one high-water measurement during 1904. It is well defined between gage heights 4 feet and 5 feet, and has been extended beyond these limits, being based on one measurement at 6.9 feet and one at 11 feet. Above 7 feet the estimate can be considered only approximate.

Estimated monthly discharge of Heart River near Richardton, N. Dak., for 1905.

[Drainage area, 1,250 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	400	12	83.1	5,110	0.066	0.076
April	12	2	5.8	345	.0046	.0051
May	9	2	5.6	344	.0045	.0052
June	292	4	36.3	2,160	.029	.032
July	812	9	125	7,686	.100	.115
August	6	.5	3.1	191	.0025	.0029
September	12	.0	2.2	131	.0017	.0019
October	6	.5	2.2	135	.0017	.0020
November 1-23	9	4	6.0	274	.0048	.0041
The period				16,380		

APPLE CREEK DRAINAGE BASIN.

APPLE CREEK NEAR BISMARCK, N. DAK.

A temporary station was established on Apple Creek 6 miles east of Bismarck, N. Dak., at the bridge on the township line between sec. 3, T. 138, and sec. 34, T. 139. The gage was read by William S. Hedges.

Discharge measurements of Apple Creek near Bismarck, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 2	Walter Skelton	16	10.8	0.99	3.20	10.7
March 6	do	27	95	2.12	6.10	200
March 8	do	21	84	2.10	5.50	159
March 24	do	9.5	15.3	1.02	1.05	15.8
April 5	do	8.5	13.6	1.12	.90	15.2
April 19	do	6	7.0	.94	.35	6.6
May 29	do	6	7.3	.80	.50	5.8
June 6	do	18	52	1.19	2.90	62
June 7	do	18	38	1.06	2.30	40
June 9	do	35	159	1.53	6.65	243
June 10	do	24	90	1.44	4.60	130

Daily gage height, in feet, of Apple Creek near Bismarck, N. Dak., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	Day.	Feb.	Mar.	Apr.	May.	June.
1		3.4	0.95	0.3	0.5	17		2.6	.3	1.0	1.5
2		3.4	.8	.3	.5	18		2.4	.3	1.0	1.4
3		3.45	.8	.3	.5	19		2.3	.35	.9	1.4
4		3.75	.95	.3	.5	20		2.2	.3	.7	1.3
5		4.4	.9	.4	2.45	21		2.15	.3	.6	1.3
6		6.05	.9	.3	2.95	22			.3	.6	1.3
7		6.45	.8	.3	2.35	23			.3	.6	1.3
8		5.7	.7	.3	3.45	24		1.05	.3	.6	1.3
9		5.4	.7	.4	6.59	25		1.1	.3	.6	1.3
10		5.2	.6	.5	4.6	26		1.1	.3	.5	1.4
11		4.0	.5	.6	4.8	27	3.4	1.1	.3	.5	1.4
12		3.75	.5	.7	4.0	28	3.4	1.1	.2	.5	2.1
13		3.2	.5	.7	2.0	29		1.05	.2	.5	
14		3.0	.5	.8	1.5	30		1.0	.2	.5	
15		2.8	.5	.9	1.5	31		1.0		.5	
16		2.6	.4	1.0	1.5						

NOTE.—Flow commenced February 27.

Estimated monthly discharge of Apple Creek near Bismarck, N. Dak., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	307	10	54.7	3,363
April	15	5	8.8	524
May	16	5	9.0	553
June 1-21	244	6	50.0	2,082

NOTE.—These estimates are only approximate.

CANNON BALL RIVER DRAINAGE BASIN.

CANNON BALL RIVER AT STEVENSON, N. DAK.

Cannon Ball River is formed by two chief branches—North and South forks. North Fork rises in White Butte, in southern Billings County, N. Dak., flows northeastward for about 20 miles and then turns abruptly to the southeast; South Fork rises in Whetstone Butte, in the western part of Hettinger County, runs southeastward for approximately 40 miles and then turns northeastward; the two streams unite about 5 miles south of Three Buttes, in south-central Morton County, whence the main stream flows to the north and east, entering the Missouri about 25 miles southeast of Bismarck, N. Dak.

The gaging station was established June 10, 1903. It is located one-half mile west-northwest of the post-office at Stevenson, in sec. 20, T. 133 N., R. 82 W., and about 40 miles south of Mandan, N. Dak.

The channel is straight for 100 feet above the station and 400 feet below. The right bank is low, slopes gradually up from the water's edge, and is covered with timber and brush; the left bank is steep and about 25 feet high. The bed of the stream consists of clay, soft mud, and loose stones, and probably shifts somewhat. The depth varies from 2 to 5 feet at low stages. The current velocity is ordinarily sluggish.

Discharge measurements are made from a car and cable about 200 feet above the gage. A tagged wire is stretched above the cable. The initial point for soundings is a point 2 feet back from the cable support on the left bank.

The gage, which was read during 1905 by Donald Stevenson, is of the chain type and was put in June 30, 1905, to replace the old gage, which was in bad condition. The new gage has a chain length of 21.76 feet. The gage is supported by four solidly set posts on top of which is a horizontal timber, and is well braced and guyed. The pulley diameter is 0.31 foot and the distance from its center to the zero of the scale is 5.57 feet. The elevation of the highest point (marked with a cross), which is near the east corner of the flat top of a large granite rock, 4 by 9 feet, rising out of a pool to the right of its middle a few feet below the gage, is 4.84 feet above gage datum. The datum of the gage is about 1,700 feet above sea level, as determined by carrying an aneroid barometer six times between this station and Mandan, N. Dak.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 64; 130, pp 153-154.
Discharge: 99, p 65; 130, p 154.
Gage heights, 99, p 65; 130; p 154-155.

Discharge measurements of Cannon Ball River at Stevenson, N. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 28	E. F. Chandler	114	168	0.59	3.56	99
June 29[a]	do	40	56	2.19	3.45	123
June 30[a]		68	132	.87	3.49	114
August 3[a]	R. Richards	68	120	.85	3.52	102
August 28[a]	do	38	32	.62	2.88	20
August 29[a]	do	34	21	.92	2.85	19
October 17[a]	E. F. Chandler	14	9.6	.50	2.61	4.8

[a] Made by wading.

Daily gage height, in feet, of Cannon Ball River at Stevenson, N. Dak., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	7.4	3.7	2.8	2.5	3.5	3.0	2.9	2.0	3.0
2	.....	7.2	3.5	2.9	2.7	3.5	3.3	2.9	1.8	3.0
3	.....	7.0	3.5	3.2	2.8	3.5	3.5	2.7	1.8	3.1
4	.....	6.9	3.4	4.1	2.8	4.1	3.2	2.7	1.9	3.2
5	.....	6.2	3.3	5.2	6.2	4.3	3.8	2.6	1.9	3.2
6	.....	6.2	3.3	5.7	6.2	4.5	3.3	2.5	1.9	3.2
7	.....	6.0	3.3	5.7	6.1	4.8	3.0	2.5	1.9	3.1
8	.....	3.9	3.2	5.6	7.1	5.2	2.8	2.4	1.5	3.1
9	.....	4.0	3.2	5.1	6.5	4.7	2.6	2.3	1.5	2.9
10	.....	4.1	3.2	4.8	3.6	4.5	2.6	2.6	1.5	2.7
11	.....	4.2	3.1	4.8	3.5	4.3	2.4	2.6	1.3	2.7
12	.....	4.2	3.1	4.3	3.5	5.2	2.6	2.5	1.0	2.7
13	.....	4.2	3.2	3.8	3.2	5.0	2.6	2.3	.8	2.7
14	.....	4.1	3.2	3.6	2.9	4.5	2.7	2.3	.8	2.8
15	.....	4.1	3.3	3.3	2.9	4.4	2.7	2.5	.8	2.8
16	.....	3.9	3.1	3.3	2.8	4.6	2.8	2.6	2.4	2.8
17	.....	3.9	3.1	3.2	2.6	5.3	2.9	2.8	2.6	2.9
18	.....	3.7	3.0	3.2	2.6	5.0	2.9	2.8	2.6	2.9
19	.....	3.7	3.0	3.0	2.4	4.7	3.9	2.7	2.6	2.9
20	.....	3.7	3.0	3.0	2.4	4.7	3.9	2.7	2.7	2.9
21	.....	3.8	2.9	3.0	2.9	3.5	3.8	2.5	2.7	2.8
22	.....	4.0	2.8	3.1	2.9	3.3	3.8	2.5	2.8	2.9
23	4.7	3.7	2.8	3.1	3.9	3.5	4.0	2.6	2.8	2.9
24	5.7	3.5	2.8	2.9	3.8	3.4	4.0	2.4	2.9	3.0
25	6.4	3.4	2.7	2.8	3.4	3.2	3.8	2.4	2.9	3.0
26	8.4	3.5	2.7	2.6	3.3	3.2	2.9	2.3	2.8	.....
27	8.9	3.4	2.7	2.6	3.3	3.0	3.0	2.2	2.8	.....
28	8.0	3.6	2.6	2.6	2.6	3.0	3.2	2.2	2.7	.....
29	.....	3.6	2.8	2.5	2.9	2.8	3.2	2.0	2.8	.....
30	.....	3.7	2.8	2.5	3.5	2.8	3.1	2.0	2.8	.....
31	.....	3.8	.....	2.5	.....	3.0	3.0	.....	2.9	.....

NOTE.—River frozen November 26.

GRAND RIVER DRAINAGE BASIN.

GRAND RIVER AT SEIM, S. DAK.

Grand River is formed by North and South forks, which rise in the hills of northwestern South Dakota and unite at Seim, whence the main stream flows eastward to its point of junction with the Missouri. The country drained is gently rolling and the soil is a sandy loam. There is very little land under cultivation. The only timber is along the banks of the river and its few tributaries. The main floods occur in March, May, June, and July.

The gaging station was established June 6, 1904. It is located just below the junction of North and South forks, about 800 feet east of the store at Seim. The channel is curved for about 200 feet above and 300 feet below the station. The right bank is low, somewhat wooded with scattered trees, and is subject to overflow; the left bank is high and clean and does not overflow. The bed is composed of sand and gravel and is free from vegetation and permanent. There is but one channel at high water, but during low stages there are three channels above the gage and one channel below. The current is swift. The flow ceases for a month or more in August and September. Gage heights range from 1.5 to 10 feet.

Discharge measurements are made by wading near the gage or, during high water, by floats. The initial point for soundings is the 3-foot mark of the gage.

The gage, which was read during 1905 once each day by James McGee, is inclined and in two sections. It is fastened to a tree and to posts set in the left bank. The gage is referred to bench marks as follows: (1) A railroad spike in the tree to which the upper section of the gage is attached; elevation, 9.10 feet above the zero of the gage. (2) A railroad spike driven into a cottonwood tree 125 feet from the left bank, opposite the gage; elevation, 14.08 feet above the zero of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 155-156.

Discharge measurements of Grand River at Seim, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 1	H. D. Comstock	18	5.4	1.07	1.64	5.8
May 1	do	18	6.0	1.05	1.64	6.3
July 16	do	56	57.0	2.21	2.45	126
August 21	Stevens and Comstock	50	38.0	1.53	2.09	58

Daily gage height, in feet, of Grand River at Seim, S. Dak., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Oct.	Nov.
1	.....	1.7	2.0	2.2	2.1	.....	1.7
2	2.0	1.7	2.0	2.2	2.0	.....	1.7
3	2.0	2.0	2.0	4.0	2.0	.....	1.6
4	2.0	3.0	2.0	3.6	2.1	1.8	1.6
5	2.0	3.0	2.0	3.5	2.1	1.8	1.6
6	2.0	2.8	2.6	3.0	2.0	1.7	1.6
7	2.0	1.6	2.6	2.7	1.9	1.6	1.7
8	2.0	1.6	2.5	2.5	1.9	1.6	1.7
9	2.0	1.6	9.4	2.5	1.8	1.6	1.6
10	1.9	1.6	3.2	2.4	1.8	1.6	1.6
11	1.9	1.6	3.2	2.4	1.8	1.6	1.6
12	1.8	1.6	3.2	2.2	1.8	1.6	1.6
13	1.8	1.6	3.6	2.2	1.8	1.6	(a)
14	1.8	1.5	3.6	2.2	1.8	1.6	.....
15	1.7	1.5	3.6	2.1	1.8	1.6	.....
16	1.7	1.5	3.6	2.4	1.8	1.7	1.7
17	1.7	1.5	3.6	2.5	4.5	1.7	1.6
18	1.7	1.5	4.0	2.6	3.2	1.7	1.7
19	1.7	1.5	4.9	2.6	2.6	1.6	1.6
20	1.7	1.5	4.6	2.8	2.3	1.6	1.6
21	1.7	1.6	4.5	2.9	2.3	1.7	1.6
22	1.7	1.7	3.0	2.7	2.0	1.7	1.7
23	1.7	1.7	2.8	2.5	1.8	1.7	1.6
24	1.7	2.0	2.5	2.3	1.6	1.7	.....
25	1.7	2.0	2.5	2.3	1.6	1.6	.....
26	1.7	1.8	2.5	2.3	1.6	1.6	.....
27	1.7	1.8	2.4	2.2	1.6	1.6	.....
28	1.7	1.8	2.4	2.1	1.6	1.6	.....
29	1.7	1.9	2.2	2.6	(a)	1.7	.....
30	1.7	1.9	2.2	2.4	.....	1.7	.....
31	.....	2.0	.....	2.1	.....	1.8	.....

a No flow; water standing in pools, August 29 to October 3, and November 13 to 15, inclusive.

Station rating table for Grand River at Seim, S. Dak., from June 6, 1904, to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	1	2.10	60	2.70	190	3.30	388
1.60	4	2.20	76	2.80	219	3.40	424
1.70	10	2.30	94	2.90	250	3.50	461
1.80	20	2.40	115	3.00	283		
1.90	32	2.50	138	3.10	317		
2.00	45	2.60	163	3.20	352		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904–5, and is well defined between gage heights 1.5 feet and 3.5 feet. The discharge above 3.5 feet is only approximate.

Estimated monthly discharge of Grand River near Seim, S. Dak., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 6–30	669	60	168	8,331
July 1–20	60	0	40.2	1,595

NOTE.—Dry after July 20.

Estimated monthly discharge of Grand River at Seim, S. Dak., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 2–30	45	10	22.2	1,277
May	283	1	37.7	2,318
June	3,500	45	423	25,170
July	669	60	167	10,270
August 1–28	909	4	79.9	4,913
October 4–31	20	4	7.9	439
November (1–12) (16–23)	10	4	6.1	242
The period	.....	.....	.....	44,630

NOTE.—No flow August 29 to October 3 and November 13 to 15, inclusive. Water standing in pools.

MOREAU RIVER DRAINAGE BASIN.

MOREAU RIVER AT BIXBY, S. DAK.

Moreau River rises near the western boundary of South Dakota and flows eastward into the Missouri. The country drained is high and rolling and the soil is a sandy loam. There is very little land under cultivation. There is no timber except along the banks of the river and its tributaries, of which the chief are North and South Forks, Rabbit Creek, and Thunder Butte Creek. The principal floods occur in March, May, June, and July.

The gaging station was established June 4, 1904. It is located one-fourth mile southeast of Bixby, S. Dak., in T. 14 N., R. 13 E., about 1,000 feet below the ford.

The channel is straight for 1,000 feet above and below the gage. The left bank is high and clean and does not overflow; the right bank is timbered and is liable to overflow in extremely high water. The bed of the stream is composed of sandstone, contains much clay and fine sand, and is free from vegetation and permanent. There is but one channel at all stages. The current is swift at high water, but becomes sluggish at low water.

Gage heights range from 1 to 10 feet. The river is frozen from about December 1 to March 10, and observations are discontinued during that period.

High-water measurements are made by means of a car and cable 200 feet above the gage. The initial point for soundings is the right cable support. The cable is marked at 10-foot intervals with red paint. Low-water measurements are made by wading 100 feet below the gage.

A staff gage, which was read once each day during 1905 by J. A. Hudgins, is driven in an inclined position into the bed of the stream and is firmly spiked to two small trees on the right bank. In order that the gage heights may be read during floods, a second section is attached to a large cottonwood tree 50 feet from the bank. The gage is referred to bench marks as follows: (1) A railroad spike driven into the base of a cottonwood tree 75 feet from the gage on the right bank; elevation, 13.98 feet above the zero of the gage. (2) A railroad spike driven into the base of a cottonwood tree 100 feet from the gage and 75 feet downstream from the first bench mark; elevation, 13.95 feet above the zero of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 156–159, 192.

Discharge measurements of Moreau River at Bixby, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28 [a]	H. D. Comstock	32	4.8	0.96	1.35	4.6
May 3 [a]	do	85	76	1.67	2.10	127
May 5 [a]	do	82	124	2.00	2.60	249
May 6	do	82	211	3.10	3.54	654
May 6	do	82	228	3.16	3.72	721
May 7	do	90	300	3.90	4.47	1,170
May 7	do	91	331	4.12	4.85	1,365
July 15 [a]	do	86	140	2.17	2.91	304
July 17 [a]	do	91	191	2.56	3.32	489
August 19	Stevens and Comstock	84	212	2.78	3.65	589

[a] Made 100 feet below cable.

Daily gage height, in feet, of Moreau River at Bixby, S. Dak., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.5	1.3	1.5	1.7	1.7	4.6	1.5	1.7
2	.....	1.5	1.4	1.6	2.1	1.6	3.5	1.5	1.7
3	.....	1.5	2.1	2.0	6.1	1.55	2.4	1.5	1.6
4	.....	1.5	2.5	1.8	5.3	1.5	2.0	1.5	1.6
5	.....	1.4	2.65	1.6	4.1	1.5	1.8	1.5	1.6
6	.....	1.4	3.7	1.5	2.8	1.5	1.7	1.45	1.6
7	.....	1.4	4.6	1.5	2.35	1.5	1.6	1.45	1.6
8	.....	1.4	3.4	1.5	2.0	1.5	1.6	1.5	1.6
9	.....	1.3	3.0	1.5	1.9	1.5	1.6	1.5	1.6
10	.....	1.35	2.8	1.45	1.8	1.4	1.6	1.5	1.6
11	.....	1.4	2.5	1.45	1.7	1.4	1.6	1.5	1.6
12	.....	1.4	2.15	1.4	1.6	1.4	1.6	1.5	1.6
13	.....	1.4	1.9	1.4	6.9	1.6	1.6	1.5	1.6
14	1.5	1.4	1.9	1.5	3.9	1.5	1.6	1.5	1.6
15	1.5	1.4	1.85	1.9	2.5	1.5	1.6	1.5	1.6
16	1.5	1.5	1.7	2.9	2.4	4.8	1.6	1.5	1.6
17	1.5	1.5	1.6	3.0	3.3	7.0	1.5	1.5	1.6
18	1.5	1.5	1.5	6.75	2.5	5.5	1.5	1.5	1.6
19	1.5	1.7	1.5	6.4	3.3	3.7	1.5	1.7	1.6
20	1.5	1.7	1.5	4.8	3.1	2.8	1.5	1.7	1.6
21	1.5	1.5	1.5	3.4	2.15	2.0	1.5	1.7	1.6
22	1.5	1.5	1.5	3.0	1.9	1.8	1.5	1.7	1.6
23	1.5	1.5	1.4	2.15	1.8	1.6	1.5	1.7	1.6
24	1.5	1.4	1.4	2.0	1.7	1.6	1.5	1.7	1.6
25	1.5	1.4	1.4	1.9	1.7	1.6	1.5	1.7	1.6
26	1.45	1.4	1.4	1.85	1.7	1.6	1.5	1.7	.....
27	1.45	1.3	1.4	2.0	2.5	1.6	1.5	1.7	.....
28	1.45	1.35	1.4	1.9	2.25	1.5	1.5	1.7	.....
29	1.45	1.3	1.45	1.85	1.9	1.5	1.5	1.85	.....
30	1.5	1.3	1.45	1.6	1.8	1.5	1.5	1.75	.....
31	1.5	.....	1.4	.....	1.75	6.4	.....	1.7	.....

Station rating table for Moreau River at Bixby, S. Dak., from March 14 to November 25, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	0	2.30	158	3.30	490	4.20	958
1.40	5	2.40	184	3.40	534	4.30	1,020
1.50	12	2.50	211	3.50	580	4.40	1,084
1.60	23	2.60	240	3.60	628	4.50	1,151
1.70	37	2.70	271	3.70	678	4.60	1,220
1.80	53	2.80	303	3.80	730	4.70	1,292
1.90	71	2.90	337	3.90	784	4.80	1,366
2.00	91	3.00	372	4.00	840	4.90	1,442
2.10	112	3.10	409	4.10	898	5.00	1,520
2.20	134	3.20	448				

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904–5, and is well defined between gage heights 1.3 feet and 5 feet. Above 5 feet the discharge is approximate.

Estimated monthly discharge of Moreau River at Bixby, S. Dak., for 1905.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean		Second-feet per square mile.	Depth in inches.
March 14-31	12	8	11.1	398	0.0069	0.0046
April	37	0	8.6	512	.0054	.0060
May	1,220	0	142	8,731	.089	.103
June	3,044	5	323	19,220	.202	.225
July	3,196	23	415	25,520	.259	.299
August	3,300	5	348	21,400	.218	.251
September	1,220	12	85.4	5,082	.053	.059
October	62	8	23.3	1,433	.015	.017
November 1-25	37	23	24.1	1,195	.015	.014
The period				83,490		

CHEYENNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Cheyenne River rises in the eastern part of Wyoming, flows eastward around the southern border of the Black Hills, turns to the northeast, and unites with the Missouri in the central part of South Dakota. It drains a long narrow valley bordered by high table-lands and occasional low flats containing a few thousand acres each. In the Black Hills region, where many of the tributaries rise, extensive forests occur, and there is also considerable timber along the main stream. The soil is partly a sandy loam and partly gumbo, and there are many cultivated tracts.

The principal tributaries are Beaver and Hat creeks, Fall River, Battle, Spring, Rapid, and Boxelder creeks, Belle Fourche River, and Sulphur Creek. The chief tributaries of the Belle Fourche are Redwater River and Whitewood Creek, and the Redwater has one large tributary, Spearfish Creek.

The rainfall varies from 21 inches in the Black Hills region to 12 inches on the prairies. The main floods occur in March, May, June, and July. Many of the streams rising in the Black Hills are fed to a large extent by springs. Fall River, in particular, gets much of its water from hot springs and mineral springs.

There is considerable power development on the Black Hills tributaries, especially on Rapid and Whitewood creeks. Some water is diverted for irrigation from practically all the tributaries, and work is now in progress on the Belle Fourche project by the United States Reclamation Service, which proposes to divert and store nearly all the flow of the Belle Fourche at the town of Belle Fourche and to irrigate about 90,000 acres.

Information in regard to this basin is contained in the annual reports of the reclamation service and in the Fourth Annual Report of the United States Geological Survey, Part IV, pages 251-253.

CHEYENNE RIVER AT EDGEMONT, S. DAK.

This station was established June 19, 1903. It is located at the highway bridge just downstream from the Chicago, Burlington and Quincy Railway bridge, in the SE. ¼ sec. 36, T. 8 S., R. 2 E., just above the mouth of Cottonwood Creek.

The channel is straight above and below the station. The right bank is high and clean and does not overflow; the left bank is low, has a few scattered trees, and is liable to overflow. The bed of the stream is sandy and shifting. There is usually but one channel. The velocity is sluggish at low water. Gage heights range from 1 to 11 feet. The river is frozen from about December 1 to March 10.

Discharge measurements are made from the highway bridge. The initial point for soundings is a brass-headed tack surrounded by similar tacks in the first post of the lower hand rail on the south end of the bridge.

During 1905 the gage was read once each day by Hubert Wiedenfeld. The standard chain gage, installed May 17, 1905, is bolted to the lower chord of the downstream truss of the right span of the bridge, 50 feet from the right end. The length of the chain is 13.45 feet. The gage is referred to bench marks as follows: (1) A nail surrounded by a circle of brass tacks driven into a knot on the south side of a cottonwood tree 250 feet north of the north end of the highway bridge; elevation, 11.29 feet above the zero of the gage. (2) The corner of the abutment at the north end of the railroad bridge, on the fourth step of the abutment and on the corner on the east side away from the bridge; elevation above the zero of the gage, 20.23 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 55–56; 130, p 159.
Discharge: 49, p 272; 99, p 56; 130, p 160.
Gage heights: 99, p 56; 130, p 160.

Discharge measurements of Cheyenne River at Edgemont, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 28	F. M. Madden	57	20.0	1.50	1.80	30
April 7	H. D. Comstock	28	15.8	1.39	1.75	22
May 17[a]	do	15	4.7	1.32	2.28	6.2
June 14[a]	do	84	98	2.78	2.75	272
June 15[a]	do	72	77	2.23	2.50	172
June 15	do	150	382	3.50	4.20	1,336
June 16	do	148	247	2.43	3.30	599
June 16	do	147	206	2.28	3.10	469
June 18	do	300	1,652	5.60	9.75	9,259
June 19	do	154	575	4.31	4.62	2,477
June 19	do	154	474	3.53	4.00	1,674
August 4	do	162	578	3.34	4.23	1,930
August 5	do	162	274	2.46	2.95	674
August 6	do	270	1,285	5.62	8.00	7,222
August 6	do	250	1,157	5.09	7.55	5,893
August 6	do	220	968	4.96	6.80	4,803
August 7	do	175	730	4.77	5.60	3,485
August 8	do	162	359	2.82	3.64	1,014
September 6	Stevens and Comstock	94	45	1.44	2.35	65

[a] Made at different sections.

Daily gage height, in feet, of Cheyenne River at Edgemont, S. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	3.8	4.0	1.8	1.7	2.5	2.7	6.3	2.5	2.3	2.2	2.1
2	2.9	3.8	3.8	2.8	2.8	2.5	9.25	5.3	2.7	3.0	2.1	2.1
3	3.0	3.8	3.6	2.0	3.8	2.5	5.8	5.0	2.8	2.6	2.1	.....
4	3.0	3.8	3.5	2.0	2.5	2.5	5.0	4.0	2.6	2.6	2.2	.....
5	3.0	4.0	3.0	1.8	2.0	2.5	4.0	2.95	2.4	2.4	2.1	.....
6	3.0	4.0	2.5	1.8	2.0	2.5	3.0	7.95	2.2	2.4	2.1	.....
7	3.0	4.0	2.4	1.8	2.5	2.5	2.3	4.0	2.2	2.0	2.1	.....
8	3.0	4.0	2.4	1.8	2.5	2.6	3.4	3.7	2.2	2.3	2.1	.....
9	3.0	4.0	2.4	1.8	2.5	2.6	2.8	3.0	2.1	2.3	2.1	.....
10	3.0	4.0	2.4	1.8	2.3	2.6	2.8	2.2	2.1	2.3	2.1	.....
11	3.0	4.0	2.4	1.8	2.3	5.0	2.8	5.0	2.1	2.2	2.1	.....
12	3.0	4.0	2.4	1.8	2.3	4.2	2.7	8.4	2.1	2.3	2.1	.....
13	3.0	4.3	2.3	1.8	2.3	4.2	2.5	5.8	2.1	2.3	2.1	.....
14	3.0	4.3	2.3	2.2	2.3	5.0	2.8	4.0	2.1	2.4	2.1	.....
15	3.0	4.3	2.0	2.0	2.3	5.5	2.7	3.3	2.2	2.4	2.1	.....
16	3.0	4.3	2.0	2.0	2.2	3.8	2.6	3.0	2.2	2.4	2.1	.....
17	3.0	4.3	2.0	2.0	2.2	5.45	2.5	2.4	2.2	2.4	2.1	.....
18	3.0	4.3	2.0	2.0	2.3	9.65	2.3	2.3	2.1	2.3	2.1	.....
19	3.0	4.3	2.0	2.0	2.3	4.4	2.1	2.3	2.1	2.3	2.1	.....
20	3.0	4.3	2.0	2.0	2.4	3.4	7.7	2.2	2.1	2.1	2.1	.....
21	3.0	4.3	2.0	2.0	2.4	2.6	5.9	2.0	2.0	2.1	2.1	.....
22	3.3	4.5	1.9	2.0	2.4	2.6	4.8	2.6	2.0	2.1	2.1	.....
23	3.3	4.5	1.9	2.0	4.5	2.4	3.3	2.0	2.0	2.1	2.1	.....
24	3.3	5.0	1.9	2.0	4.8	3.0	2.8	1.9	2.0	2.1	2.1	.....
25	3.3	4.7	1.9	1.9	2.8	3.0	2.6	2.0	2.0	2.1	2.1	.....
26	3.3	4.5	1.9	1.9	2.8	2.7	2.4	2.6	2.0	2.1	2.1	.....
27	3.3	4.3	1.8	1.8	2.4	2.6	4.1	2.4	2.0	2.1	2.1	.....
28	3.3	4.2	1.8	1.7	2.4	2.4	6.0	2.3	2.0	2.1	2.1	.....
29	3.5	.....	1.8	1.7	2.3	2.0	10.7	2.3	2.0	2.0	2.1	.....
30	3.5	.....	1.8	1.7	2.3	2.6	9.7	2.3	2.0	2.0	2.1	.....
31	3.5	.....	1.8	.....	2.6	.....	6.0	2.3	.....	2.0	.....	.....

NOTE.—Ice conditions January 1 to February 22, inclusive.

Daily discharge, in second-feet, of Cheyenne River at Edgemont, S. Dak., 1903–1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.											
1	.....	.....	.....	.....	.....	375	1,685	318	10	4	57
2	.....	.....	.....	.....	.....	318	3,005	226	8	4	57
3	.....	.....	.....	.....	.....	23	1,795	130	8	4	57
4	.....	.....	.....	.....	.....	14	1,472	106	8	5	57
5	.....	.....	.....	.....	.....	10	1,092	75	8	5	57
6	.....	.....	.....	.....	.....	5	848	75	8	5	75
7	.....	.....	.....	.....	85	4	630	75	4	5	75
8	.....	.....	.....	.....	66	2	435	57	4	2	.....
9	.....	.....	.....	.....	269	2	246	117	4	2	.....
10	.....	.....	.....	.....	130	2	171	117	4	2	.....
11	.....	.....	.....	.....	75	4,290	95	106	4	2	.....
12	.....	.....	.....	.....	41	5,170	3,330	106	4	2	.....
13	.....	.....	.....	.....	34	1,740	1,320	5,720	5	2	.....
14	.....	.....	.....	.....	23	665	1,050	1,472	5	2	.....
15	.....	.....	.....	.....	18	405	665	925	5	2	.....
16	.....	.....	.....	.....	106	171	530	700	5	2	.....
17	.....	.....	.....	.....	171	6,680	345	405	5	2	.....
18	.....	.....	.....	.....	85	4,150	246	246	5	10	.....
19	.....	.....	.....	.....	49	1,320	171	171	5	28	.....
20	.....	.....	.....	.....	41	292	142	117	5	28	.....
21	.....	.....	.....	.....	34	206	75	75	5	28	.....
22	.....	.....	.....	.....	226	117	57	57	2	28	.....
23	.....	.....	.....	.....	66	66	57	57	2	28	.....
24	.....	.....	.....	.....	57	188	41	28	4	41	.....
25	.....	.....	.....	.....	49	1,472	885	18	4	41	.....
26	.....	.....	.....	.....	49	562	595	10	4	41	.....
27	.....	.....	.....	.....	49	925	1,050	10	4	41	.....
28	.....	.....	.....	.....	2,080	700	885	10	4	41	.....
29	.....	.....	.....	.....	1,850	435	735	10	4	75	.....
30	.....	.....	.....	.....	1,740	562	562	10	4	57	.....
31	.....	.....	.....	.....	.....	1,180	435	.....	4	.....	.....
1904.											
1	.....	.....	57	665	2,940	117	18	735	4	1	.....
2	.....	.....	57	562	2,080	3,730	18	246	4	1	.....
3	.....	.....	57	345	6,760	3,135	18	95	4	1	.....
4	.....	.....	57	772	4,010	925	18	292	4	1	.....
5	.....	.....	57	435	2,440	345	18	117	4	1	.....
6	.....	.....	57	206	1,180	2,565	18	57	4	1	.....
7	.....	.....	57	171	848	1,850	18	34	4	1	.....
8	.....	.....	41	130	665	1,525	18	34	4	1	.....
9	.....	.....	41	106	3,395	1,320	18	14	4	1	.....
10	.....	.....	41	85	1,472	1,135	10	8	4	1	.....
11	.....	.....	28	66	885	885	10	8	8	1	.....
12	.....	.....	28	49	562	735	10	8	14	1	.....
13	.....	.....	28	34	292	1,225	10	4	34	4	.....
14	.....	.....	18	34	142	665	10	1	156	8	.....
15	.....	.....	18	41	95	405	5	1	188	4	.....
16	.....	142	18	41	772	246	5	1	130	4	.....
17	.....	117	18	41	595	171	5	1	106	1	.....
18	.....	95	18	41	292	117	4	1	66	1	.....
19	.....	57	18	41	142	75	4	0	34	1	.....
20	.....	57	18	41	95	57	4	0	8	1	.....
21	.....	57	18	4,290	75	57	4	0	8	14	.....
22	.....	57	10	3,330	965	41	1	0	8	14	.....

Daily discharge, in second-feet, of Cheyenne River at Edgemont, S. Dak., 1903–1905—Cont'd.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.											
23	.....	57	10	2,200	665	57	1	0	4	34	.....
24	.....	57	8	1,050	405	41	1	0	4	66	.....
25	.....	57	4	848	292	28	1	0	4	85	.....
26	.....	57	4	700	142	28	1	0	4	85	.....
27	.....	57	4	595	345	18	1	0	4	.....	.....
28	.....	57	4	530	246	18	0	23	4	.....	.....
29	.....	57	4	465	206	18	0	23	4	.....	.....
30	.....	57	4	405	171	18	595	8	1	.....	.....
31	.....	57	.....	595	.....	18	1,320	.....	1	.....	.....
1905.											
1	.....	1,135	28	18	171	345	4,290	117	57	41	.....
2	.....	965	292	292	171	8,665	2,940	171	246	28	.....
3	.....	810	57	965	171	3,460	2,565	206	117	28	.....
4	.....	735	57	171	171	2,440	1,420	142	117	41	.....
5	.....	405	28	57	171	1,320	562	95	75	28	.....
6	.....	171	28	57	171	530	6,842	41	75	28	.....
7	.....	142	28	117	171	117	1,420	41	18	28	.....
8	.....	142	28	117	206	665	1,050	41	57	28	.....
9	.....	142	28	117	206	292	530	28	57	28	.....
10	.....	142	28	75	206	292	142	28	57	28	.....
11	.....	142	28	57	2,200	292	2,440	28	41	28	.....
12	.....	142	28	57	1,320	246	7,420	28	57	28	.....
13	.....	117	28	57	1,320	171	3,460	28	57	28	.....
14	.....	117	95	57	2,200	292	1,320	28	75	28	.....
15	.....	57	57	57	2,815	246	735	41	75	28	.....
16	.....	57	57	41	965	206	465	41	75	28	.....
17	.....	57	57	41	2,752	171	171	41	75	28	.....
18	.....	57	57	57	9,175	117	142	28	57	28	.....
19	.....	57	57	57	1,850	75	142	28	57	28	.....
20	.....	57	57	75	885	6,280	117	28	28	28	.....
21	.....	57	57	75	345	3,595	57	18	28	28	.....
22	.....	41	57	75	345	2,200	206	18	28	28	.....
23	1,630	41	57	1,630	246	735	57	18	28	28	.....
24	2,200	41	57	1,965	595	405	41	18	28	28	.....
25	1,850	41	41	292	595	292	57	18	28	28	.....
26	1,630	41	41	292	345	206	171	18	28	28	.....
27	1,420	28	28	142	292	1,420	117	18	28	28	.....
28	1,320	28	18	142	206	3,730	95	18	28	28	.....
29	.....	28	18	117	95	10,960	95	18	18	28	.....
30	.....	28	18	117	292	9,260	95	18	18	28	.....
31	.....	28	.....	206	.....	3,730	95	.....	18	.....	.....

NOTE.—The daily discharge has been obtained by the indirect method.

Estimated monthly discharge of Cheyenne River at Edgemont, S. Dak., 1903–1905.

[Drainage area, 7,350 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1903.						
June 7–30	2,080	18	308	14,660	0.042	0.037
July	6,680	2	1,034	63,580	.141	.163
August	3,330	41	795	48,880	.108	.124
September	5,720	10	385	22,910	.524	.585
October	10	2	5.0	307	.00068	.00078
November	75	2	18.0	1,071	.0024	.0027
December 1–7	75	57	62.1	862	.0062	.0021
The period				152,300		
1904.						
March 16–31	142	57	68.4	2,171	.0093	.0055
April	57	4	26.7	1,589	.0036	.0040
May	4,290	34	610	37,510	.083	.096
June	6,760	75	1,106	65,810	.150	.167
July	3,730	18	696	42,800	.095	.110
August	1,320	0	69.8	4,292	.0095	.011
September	735	0	57.0	3,392	.0078	.0087
October	188	1	26.9	1,654	.0037	.0043
November 1–26	85	1	12.8	6,601	.0017	.0017
The period				165,800		
1905.						
February 23–28	2,200	1,320	1,675	19,930	.228	.051
March	1,135	28	195	11,990	.027	.031
April	292	18	50.5	3,005	.0069	.0077
May	1,965	18	245	15,060	.033	.038
June	9,175	95	1,022	60,810	.139	.155
July	10,960	75	2,024	124,400	.275	.317
August	7,420	41	1,266	77,840	.172	.198
September	206	18	47.0	2,797	.0064	.0071
October	246	18	56.5	3,474	.0077	.0089
November	41	28	28.9	1,720	.0039	.0044
The period				321,000		

NOTE.—No estimate for ice period.

BEAVER CREEK NEAR EDGEMONT, S. DAK.

Beaver Creek rises in the northern part of Weston County, Wyo., flows southeastward, and enters Cheyenne River in the northwestern part of Fall River County, S. Dak.

The gaging station was established April 7, 1905. It is located at Anderson's ranch, about 16 miles northwest of Edgemont, S. Dak., and about 2 miles west of the Argentine water tank on the Chicago, Burlington and Quincy Railroad, just below the mouth of Pass Creek, in the S. ½ sec. 16, T. 7 S., R. 1 E.

The channel is straight for 200 feet above and below the station. Both banks are low and are liable to overflow during high water. The bed of the stream at the measuring section is of gravel and cobblestones and is fairly permanent; at the gage the bed is composed of mud. At the measuring section there is one channel at high water, but at low water there are two channels; at the gage there is but one channel at all stages. The current is fairly swift. Gage heights range from 1 foot to 9 feet. The stream is frozen from about December 1 to March 10, and observations are discontinued during that time.

Discharge measurements are made by wading near a ford 1,000 feet below the gage. The initial point for soundings is a stake on the right bank in line with a crotched fence post and a dead tree.

The gage, which was read once each day during 1905 by H. Anderson, is a post supporting a plank step on the right bank, graduated from zero to 4 feet; a second post, higher up on the bank, about 30 yards from the house of the observer, is graduated from 4 to 8.5 feet. The bench mark is a spike driven 6 inches above the base of a cottonwood tree 100 feet above the gage; elevation, 9.59 feet above zero of gage.

Discharge measurements of Beaver Creek near Edgemont, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 7	H. D. Comstock	38	24.0	0.87	1.21	20
May 17	do	22	7.8	.59	.85	4.6
June 14	do	28	14.0	1.74	1.24	23
June 17	do	24	9.6	.98	.98	9.4
August 4	do	80	99.0	3.15	2.90	312
August 8	do	52	41.0	2.37	1.80	93
September 7	Stevens and Comstock	25	10.7	1.06	1.00	11.4

Daily gage height, in feet, of Beaver Creek near Edgemont, S. Dak., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.05	2.7	3.2	3.4	1.0	1.0	1.1
2	.....	1.55	2.0	8.4	6.9	1.2	2.0	1.2
3	.....	1.4	1.2	7.45	5.4	1.1	2.5	1.2
4	.....	1.2	1.0	5.8	3.5	1.0	1.6	1.15
5	.....	1.1	.9	3.1	2.2	1.0	1.4	1.1
6	.....	1.0	1.2	2.2	4.2	1.0	1.2	1.1
7	1.2	1.2	1.1	3.25	2.6	1.0	1.1	1.1
8	1.2	1.1	1.0	2.9	1.85	1.0	1.1	1.0
9	1.2	1.1	.9	1.8	1.7	1.0	1.0	1.0
10	1.3	1.1	2.9	1.4	1.8	1.0	1.0	1.0
11	1.25	1.0	3.35	1.4	1.85	1.0	1.0	1.0
12	1.2	.9	2.9	1.35	1.4	1.0	1.0	1.0
13	1.2	.8	1.5	1.3	1.4	1.0	1.0	1.0
14	1.2	.8	1.3	2.4	2.8	1.0	1.0	1.05
15	1.2	.8	1.2	1.65	2.1	1.0	1.0	1.05
16	1.2	.8	1.1	1.4	1.6	1.0	1.0	1.05
17	1.25	.8	1.0	1.25	1.4	1.0	1.0	1.1
18	1.2	.8	1.25	1.2	1.3	1.0	1.0	1.1
19	1.2	1.3	1.3	1.1	1.25	1.0	1.0	1.1
20	1.15	1.4	1.2	3.95	1.2	1.0	1.0	1.1
21	1.15	1.2	1.2	3.45	1.15	1.0	1.0	1.1
22	1.1	1.1	1.2	4.5	1.15	1.0	1.0	1.1
23	1.15	1.4	1.2	2.3	1.1	1.0	1.1	1.1
24	1.15	1.2	1.15	1.7	1.0	1.0	1.1	1.1
25	1.1	1.78	1.48	1.4	1.0	1.0	1.1	1.1
26	1.1	1.6	1.4	1.35	1.0	1.0	1.1	1.1
27	1.1	1.3	1.3	5.25	1.0	1.0	1.1	1.1
28	1.1	1.2	1.2	4.4	1.0	1.0	1.1	1.1
29	1.05	1.2	1.1	8.6	1.0	1.0	1.1	1.1
30	1.05	1.2	1.1	6.7	1.0	1.0	1.1	.....
31	.....	1.1	.....	4.4	1.0	.....	1.1	.....

HAT CREEK NEAR EDGEMONT, S. DAK.

Hat Creek enters Cheyenne River from the south in the central part of Fall River County, S. Dak.

The gaging station was established April 8, 1905. It is located at Brady's ranch, about 1 mile above the mouth of the creek, 13 miles east of Edgemont, S. Dak., in the SE. ¼ sec. 24, T. 9 S., R. 4 E.

The channel is straight for about 500 feet above and below the station. The right bank is medium high, is clean, and overflows at very high floods; the left bank is high and clean and does not overflow. The bed of the stream is composed of gravel and mud and is fairly permanent. There is but one channel at all stages and the current is swift. The stream is frozen over from about December 1 to March 10, and observations are discontinued during that period. Gage heights range from 0.5 foot to 11 feet.

Discharge measurements are made by wading 50 feet above the gage. The initial point for soundings is the bench mark.

The gage, which was read once each day during 1905 by Clarence Brady, consists of a vertical staff spiked to the crib work of an old pumping plant near the house of the observer. The bench mark is a spike in a cottonwood tree on the left bank, 50 feet above the gage and 35 feet from the water's edge; elevation above zero of gage, 10.22 feet.

Discharge measurements of Hat Creek near Edgemont, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 8	H. D. Comstock	15	7.6	1.55	0.71	11.8
May 18	do	23	12.3	1.01	.80	12.4
June 15	do	18	8.4	1.46	.73	12.3
August 7 [a]	do	115	408	4.80	5.10	1,958
August 9	do	32	34	2.50	1.70	85
September 6 [b]	Stevens and Comstock				1.10	8

[a] Float measurement.
[b] Bar below gage causes backwater; discharge estimated.

Daily gage height, in feet, of Hat Creek near Edgemont, S. Dak., for 1905.

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.6	1.6	5.4	2.0	1.1	1.0	1.0
2	.....	1.68	1.15	2.8	1.9	1.1	1.0	1.0
3	.....	2.65	1.0	4.1	2.9	1.1	.95	1.0
4	.....	4.5	.9	2.5	1.9	1.1	.95	1.0
5	.....	2.9	.9	1.9	1.6	1.1	1.0	1.0
6	.....	1.9	.8	1.5	5.7	1.1	1.0	1.0
7	.....	1.45	.8	1.5	5.2	1.1	.95	1.0
8	.....	1.2	.75	1.4	2.45	1.1	.9	1.0
9	0.6	1.0	.7	1.9	1.75	1.1	.9	1.0
10	.7	1.0	2.72	1.55	2.0	1.1	.9	1.0
11	.7	.9	2.0	1.45	2.3	1.1	.95	1.0
12	.8	.85	1.2	1.3	11.0	1.1	.95	1.0
13	.8	.9	.9	1.2	8.0	1.1	1.0	1.0
14	1.6	.85	1.8	1.1	3.0	1.1	1.0	1.0
15	1.3	.8	.8	1.1	2.2	1.1	1.0	1.0
16	1.1	.8	2.45	1.0	1.8	1.1	1.0	1.0
17	1.2	.8	.8	1.0	1.6	1.1	1.25	1.0
18	1.1	.8	5.0	1.0	1.5	1.1	1.25	1.0
19	1.0	.8	6.3	1.0	1.5	1.1	1.15	1.0
20	1.0	.8	2.6	1.2	1.5	1.1	1.1	1.0
21	.9	1.8	2.3	1.1	1.5	1.1	1.1	1.0
22	.8	1.25	2.8	2.65	1.45	1.05	1.0	1.0
23	.75	1.0	7.0	2.5	1.3	1.05	1.0	1.0
24	.7	.9	3.4	1.2	1.3	1.0	1.0	1.0
25	.7	.9	3.5	1.0	1.2	1.0	1.0	1.0
26	.65	.75	2.3	1.0	1.2	1.0	1.0	1.0
27	.6	.75	1.85	1.0	1.2	.95	1.0	1.0
28	.7	.75	1.7	.9	1.2	.9	1.0	1.0
29	.7	.8	1.55	4.5	1.15	.95	1.0	1.0
30	.65	1.85	1.8	8.5	1.1	1.0	1.0	1.0
31	.....	2.5	.....	6.2	1.1	.....	1.0	.....

Estimated monthly discharge of Hat Creek near Edgemont, S. Dak., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 9-30	111	6	24.8	1,082
May	1,660	6	134	8,239
June	3,460	10	448	26,660
July	5,300	23	519	31,910
August	9,150	8	698	42,920
September	8	0	6.3	375
October	21	0	3.6	221
November	2	2	2.0	119
The period	.....	.....	.....	111,500

NOTE.—This estimate is only approximate.

SPRING CREEK NEAR RAPID, S. DAK.

Spring Creek has its source in the Black Hills in western South Dakota, flows southeastward and then northeastward and enters Cheyenne River near Creston, S. Dak.

The gaging station was established June 27, 1903. It is located on the highway from Rapid to Hermosa, on the property of Frank Blair, in the SE. ¼ sec. 3, T. 1 S., R. 7 E.

The channel is straight for 100 feet above and 75 feet below the station. Both banks are low and subject to overflow. At the station the bed of the stream is gravelly, but above and below this point the bottom is muddy. The current is sluggish above and below the footbridge, but is swift at the point where measurements are made. The stream is frozen from about December 1 to March 10, and observations are discontinued during that period. Gage heights range from 0.5 foot to 5 feet.

Discharge measurements are made from a small plank footbridge.

The gage, which was read once each day during 1905 by Lydia Blair, is a vertical timber, spiked to a tree at the water's edge, about 100 feet above the footbridge. The gage is referred to bench marks as follows: (1) A steel nail driven into the tree to which the gage is attached; elevation, 2.14 feet. (2) A nail driven into the base of a tree about 50 feet upstream from the gage; elevation, 4.14 feet. (3) A nail driven into the roots of a tree about 75 feet downstream from the gage; elevation, 3.36 feet. Elevations are above the zero of the gage. This station was discontinued December 1, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 53; 130, pp 160-161.
Discharge: 99, p 53; 130, p 161.
Discharge, monthly: 130, p 163.
Gage heights: 99, pp 53-54; 130, pp 161-162.
Rating table: 130, p 162.

Discharge measurements of Spring Creek near Rapid, S. Dak., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 20	H. D. Comstock	11	5.5	1.02	0.91	5.6
June 24	do	30	27	.72	1.15	19.4
July 3	do	23	34	2.08	1.89	70
August 14	do	22	34	2.27	1.80	78
September 4	Stevens and Comstock	24	29	.82	1.25	24

Daily gage height, in feet, of Spring Creek near Rapid, S. Dak., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.1	1.1	3.8	1.3	1.0	1.1
2	.....	1.2	1.4	2.2	1.3	1.0	1.1
3	.....	1.1	1.7	2.2	1.3	1.0	1.1
4	1.5	1.1	1.6	2.0	1.3	1.0	1.1
5	.8	1.1	1.6	1.8	1.3	1.0	1.1
6	.9	1.1	1.6	1.8	1.3	1.0	1.1
7	1.0	1.1	1.6	1.8	1.3	1.0	1.1
8	1.0	1.0	2.0	1.7	1.3	1.0	1.1
9	1.0	1.0	2.0	1.6	1.3	1.0	1.1
10	1.0	1.1	1.9	1.6	1.3	1.0	1.1
11	1.0	1.1	1.9	1.9	1.3	1.0	1.1
12	.9	1.2	1.9	1.9	1.3	1.0	1.1
13	.9	1.1	1.7	1.9	1.3	1.0	1.1
14	.9	1.0	1.6	1.8	1.2	1.0	1.1
15	.9	1.0	1.5	1.8	1.2	1.0	1.1
16	.9	1.1	1.4	1.8	1.2	1.0	1.1
17	.9	1.2	1.4	1.7	1.2	1.0	1.0
18	.9	1.2	1.4	1.7	1.2	1.0	1.0
19	.9	1.2	1.4	1.7	1.2	1.1	1.0
20	.9	1.2	1.7	1.6	1.2	1.2	1.0
21	.9	1.2	1.7	1.6	1.2	1.1	1.0
22	.9	1.2	2.25	1.5	1.1	1.1	1.0
23	.9	1.2	1.7	1.5	1.1	1.1	1.0
24	1.0	1.2	1.5	1.5	1.1	1.1	1.0
25	1.0	1.2	1.5	1.5	1.1	1.1	1.0
26	1.0	1.2	3.8	1.5	1.1	1.1	1.0
27	1.0	1.2	1.6	1.5	1.1	1.1	1.0
28	1.0	1.2	3.9	1.4	1.1	1.1	.9
29	1.2	1.1	1.8	1.3	1.0	1.1	.9
30	1.2	1.1	1.6	1.3	1.0	1.1	.9
31	1.1	.....	1.6	1.3	.....	1.1	.....

Station rating table for Spring Creek near Rapid, S. Dak., from May 4 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	4	1.60	57	2.40	160	3.20	289
.90	6	1.70	67	2.50	175	3.30	307
1.00	10	1.80	79	2.60	190	3.40	325
1.10	15	1.90	91	2.70	206	3.50	343
1.20	21	2.00	103	2.80	222	3.60	361
1.30	29	2.10	117	2.90	238	3.70	379
1.40	37	2.20	131	3.00	255	3.80	397
1.50	47	2.30	145	3.10	272	3.90	415

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1903-1905, and is not well defined.

Estimated monthly discharge of Spring Creek near Rapid, S. Dak., for 1905.

[Drainage area, 205 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May 4-31	47	4	10.2	566	0.050	0.052
June	21	10	17.1	1,018	.083	.093
July	415	15	85.2	5,239	.416	.480
August	397	29	77.8	4,784	.380	.438
September	29	10	22.3	1,327	.109	.122
October	21	10	12.3	756	.060	.069
November	15	6	12.3	732	.060	.067
The period				14,420		

RAPID CREEK AT RAPID, S. DAK.

Rapid Creek, which enters Cheyenne River near Creston, S. Dak., has its source in the Black Hills and flows southeastward.

The gaging station was established June 10, 1903. It is located at a highway bridge one-half mile downstream from the Rapid River Milling Company's mill, and one-fourth mile north of the Chicago and Northwestern Railway in the S. E. ¼ sec. 36, T. 2 N., R. 7 E.

The channel is straight for 150 feet above and 100 feet below the station. The banks are from 12 to 15 feet high and are liable to overflow only at extreme high water. The bed of the stream is composed of mud, with embedded bowlders. At high water there are two channels, one of which is very small. The velocity is good at all stages. The stream is subject to rapid fluctuations in height, owing to the opening and closing of the head-gates on a ditch above the station. Gage heights range from 1 foot to 5 feet. The stream is frozen from about December 20 to March 10, and observations are discontinued during that time.

Discharge measurements are made from the downstream side of the highway bridge. The initial point for soundings is the center one of a group of five brass-headed tacks driven into the downstream face of the end post at the south end of the bridge.

The gage, which was read twice each day during 1905 by John Merritt, is a timber securely spiked to a timber at the south abutment of the bridge. The gage is referred to bench marks as follows: (1) A railroad spike driven near the base of the second tree from the southeast corner of a dwelling across the street from the School of Mines dormitory; elevation, 13.92 feet above the zero of the gage. (2) A railroad spike driven near the base of the first tree from the corner south of the School of Mines dormitory; elevation, 12.81 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 50-51; 130, pp 163-164.
Discharge: 49, p 272; 99, p 51; 130, p 164.
Discharge, monthly: 99, p 52; 130, p 166.
Gage heights: 99, pp 51-52; 130, p 165.
Rating table: 99, p 52; 130, pp 165-166.

Discharge measurements of Rapid Creek at Rapid, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 10 [a]	H. D. Comstock	33	38	2.48	1.70	95
May 19	do	30	77	2.31	2.10	178
May 26	do	30	72	1.99	1.95	143
June 26	do	30	70	1.91	1.91	134
July 3	do	32	104	5.38	2.95	559
July 5	do	32	102	5.08	2.9	518
August 12	do	32	115	2.15	2.21	247
September 2	do	35	106	1.10	1.69	117

[a] Made by wading.

Daily gage height, in feet, of Rapid Creek at Rapid, S. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.5	.....	1.48	1.6	1.38	2.0	2.42	2.22	1.72	1.5	1.62
2	1.6	.....	1.5	1.75	1.75	1.98	2.58	2.22	1.75	1.58	1.55
3	1.62	.....	.....	1.65	1.9	1.9	2.98	2.28	1.75	1.58	1.48
4	1.55	.....	.....	1.6	1.95	1.85	3.0	2.3	1.58	1.5	1.45
5	1.55	.....	.....	1.6	1.85	1.82	2.95	2.08	1.6	1.5	1.4
6	1.62	.....	.....	1.58	1.82	1.82	2.72	2.35	1.7	1.42	1.55
7	.....	.....	.....	1.58	1.85	1.8	2.18	2.2	1.62	1.58	1.5
8	.....	.....	.....	1.62	2.08	1.8	2.62	2.0	1.7	1.45	1.42
9	.....	.....	.....	1.65	2.22	1.78	2.68	2.18	1.55	1.48	1.48
10	.....	.....	.....	1.7	2.25	1.78	2.68	2.22	1.62	1.4	1.55
11	.....	.....	.....	1.65	2.3	1.92	2.58	2.08	1.65	1.45	1.42
12	.....	.....	.....	1.58	2.28	1.88	2.52	2.2	1.68	1.4	1.5
13	.....	.....	.....	1.75	2.25	1.78	2.45	2.2	1.6	1.35	1.38
14	.....	.....	.....	1.7	2.22	1.78	2.48	2.08	1.65	1.45	1.55
15	.....	.....	.....	1.5	2.25	2.12	2.45	2.05	1.68	1.42	1.42
16	.....	.....	1.48	1.6	2.22	1.85	2.32	2.05	1.75	1.42	1.35
17	.....	.....	1.62	1.6	2.15	1.85	2.32	2.0	1.52	1.4	1.45
18	.....	.....	1.6	1.6	2.18	1.98	2.28	2.0	1.58	1.4	1.52
19	.....	.....	1.5	1.6	2.15	2.35	2.2	2.0	1.5	1.48	1.52
20	.....	.....	1.55	1.58	2.1	1.95	2.3	1.88	1.55	1.52	1.55
21	.....	1.3	1.58	1.6	2.08	1.85	2.52	1.92	1.5	1.55	1.38
22	.....	1.4	1.6	1.6	2.02	1.95	2.45	1.85	1.52	1.58	1.45
23	.....	1.48	1.5	1.55	1.98	1.98	2.38	1.82	1.48	1.45	1.32
24	.....	1.48	1.4	1.58	2.02	1.95	2.25	1.82	1.52	1.5	1.42
25	.....	1.42	1.68	1.58	2.02	1.95	2.22	1.95	1.52	1.48	1.51
26	.....	1.48	1.58	1.52	1.98	1.85	3.18	1.88	1.45	1.45	1.48
27	.....	1.42	1.6	1.4	1.95	1.85	2.88	1.75	1.52	1.5	1.4
28	.....	1.5	1.52	1.58	2.02	1.82	3.38	1.85	1.62	1.45	.....
29	.....	.....	1.55	1.65	2.15	1.78	2.35	1.88	1.58	1.58	.....
30	.....	.....	1.4	1.58	2.2	1.72	2.2	1.65	1.55	1.58	.....
31	.....	.....	1.58	.....	2.12	.....	2.22	1.72	.....	1.55	.....

NOTE.—Ice conditions January 7 to February 20, inclusive.

Station rating table for Rapid Creek at Rapid, S. Dak., from January 1 to July 28, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	51	1.90	131	2.50	316	3.00	587
1.40	60	2.00	154	2.60	360	3.10	658
1.50	70	2.10	180	2.70	409	3.20	734
1.60	82	2.20	209	2.80	462	3.30	814
1.70	96	2.30	241	2.90	521	3.40	897
1.80	112	2.40	277				

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904–5, and is well defined between gage heights 1.5 feet and 3 feet.

Station rating table for Rapid Creek at Rapid, S. Dak., from July 29 to November 27, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	61	1.60	101	1.90	159	2.20	243
1.40	73	1.70	118	2.00	183	2.30	279
1.50	86	1.80	137	2.10	211	2.40	320

The above table is applicable only for open-channel conditions. It is based on two discharge measurements made during 1905.

Estimated monthly discharge of Rapid Creek at Rapid, S. Dak., for 1905.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 1–6	85	70	79.0	940	0.193	0.043
February 21–28	70	51	63.6	1,009	.155	.046
March	93	60	72.5	4,458	.177	.204
April	104	60	83.2	4,951	.203	.226
May	241	58	173	10,640	.422	.486
June	259	99	131	7,795	.320	.357
July	880	203	359	22,070	.876	1.01
August	299	110	195	11,990	.476	.549
September	128	80	102	6,069	.249	.278
October	98	67	84.2	5,177	.205	.236
November 1–27	104	64	82.3	4,407	.201	.202
The period				79,510		

NOTE.—Discharge interpolated March 3–15.

BOXELDER CREEK AT BLACKHAWK, S. DAK.

Boxelder Creek rises in the Black Hills in the southeastern part of Lawrence County, S. Dak., and flows southeastward into Cheyenne River.

The gaging station was established June 27, 1903. It is located at the bridge on the road leading past the church at Blackhawk, in the SE. ¼ sec. 9, T. 2 N., R. 7 E.

The channel is straight for 150 feet above and curved for 75 feet below the station. Both banks are high and cleared, but may overflow in extreme high water. The bed of the stream is stony, with soft mud near the edges, and there is considerable water grass just below the station. The bridge makes an angle of about 30° with the normal to the current. Gage heights range from 0.5 foot to 5 feet. The stream is frozen from about December 1 to March 10, and observations are discontinued during that period.

Discharge measurements are best made by wading, but at high water they may be made from the bridge. The initial point for soundings is a brass tack driven into the hand rail vertically above the gage.

The gage, which was read once each day during 1905 by R. H. Haedt, is a vertical timber securely spiked to a pile on the upstream side of the east end of the bridge. The gage is referred to bench marks as follows: (1) A spike driven about 6 inches above the base of a large fence post at the corner of the barnyard 300 feet east of the station; elevation, 16.84 feet. (2) A spike driven about 6 inches above the base of the south gatepost of a gate near a house about 500 feet from the station along the road toward Rapid; elevation, 16.81 feet. (3) A drift bolt driven in the base of a large cottonwood tree on the right bank, about 75 feet above the bridge; elevation, 4.34 feet. Elevations are above the zero of the gage. This station was discontinued December 1, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 49; 130, pp 166-167.
Discharge: 99, p 50; 130, p 167.
Discharge, monthly: 130, p 169.
Gage heights: 99, p 50; 130, pp 167-168.
Rating tables: 130, p 168.

Discharge measurements of Boxelder Creek at Blackhawk, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 20	H. D. Comstock	40	80	1.34	2.10	107
June 24 [a]	do	22	18.5	2.22	1.49	41
July 3	do	48	225	2.43	4.60	546
August 14 [a]	do	26	24	3.29	1.72	79
September 4 [a]	Stevens and Comstock	26	29	1.07	1.11	31

[a] Made by wading.

Daily gage height, in feet, of Boxelder Creek at Blackhawk, S. Dak., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.6	1.1	3.3	1.2	0.9	0.7
2	.....	1.55	5.1	2.5	1.15	.9	.8
3	.....	1.55	4.7	2.3	1.2	.9	.75
4	.....	1.5	4.3	2.15	1.11	.9	.75
5	.....	1.4	3.7	2.1	1.08	.85	.8
6	.....	1.4	3.4	2.0	1.05	.85	.8
7	.....	1.4	3.0	1.95	1.1	.8	.8
8	.....	1.3	3.0	1.9	1.1	.85	.8
9	2.0	1.28	3.2	1.8	1.1	.85	.8
10	2.5	1.28	2.7	1.7	1.05	.85	.8
11	2.65	1.6	2.7	1.88	1.0	.88	.75
12	2.6	1.5	2.65	1.9	1.1	.9	.75
13	2.55	1.4	2.4	1.9	1.1	.9	.75
14	2.5	1.3	2.35	1.75	1.05	.9	.75
15	2.4	1.2	2.2	1.7	1.0	.9	.75
16	2.35	1.3	2.08	1.6	1.0	.9	.75
17	2.25	1.4	2.0	1.52	1.0	.9	.7
18	2.1	1.58	1.9	1.5	1.0	.9	.7
19	2.05	1.6	1.8	1.5	.95	.88	.7
20	2.05	1.55	2.1	1.45	.95	.85	.7
21	2.0	1.5	2.4	1.4	.9	.82	.7
22	1.9	1.55	2.05	1.35	.9	.8	.65
23	1.8	1.55	2.0	1.3	.85	.8	.7
24	1.9	1.5	1.8	1.3	.85	.8	.75
25	1.8	1.5	1.8	1.25	.85	.8	.7
26	1.8	1.4	2.2	1.22	.8	.8	.7
27	1.8	1.35	3.28	1.3	.9	.8	.7
28	1.8	1.25	2.7	1.3	.9	.8	.6
29	1.9	1.18	2.5	1.25	.9	.75	.55
30	1.9	1.05	1.9	1.2	.9	.7	.5
31	1.75	.....	1.8	1.2	.....	.7	.....

Station rating table for Boxelder Creek at Blackhawk, S. Dak., from May 9 to July 1, 1905

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	7	1.50	42	2.00	95	2.50	161
1.10	12	1.60	51	2.10	107	2.60	176
1.20	18	1.70	61	2.20	120	2.70	191
1.30	25	1.80	72	2.30	133		
1.40	33	1.90	83	2.40	147		

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905, and is not well defined.

Station rating table for Boxelder Creek at Blackhawk, S. Dak., from July 2 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
.50	2	1.30	42	2.10	128	2.90	241
.60	4	1.40	50	2.20	141	3.00	257
.70	7	1.50	59	2.30	154	3.10	273
.80	11	1.60	69	2.40	168	3.20	289
.90	16	1.70	80	2.50	182	3.30	306
1.00	21	1.80	91	2.60	196	3.40	323
1.10	27	1.90	103	2.70	211		
1.20	34	2.00	115	2.80	226		

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905, and is not well defined.

Estimated monthly discharge of Boxelder Creek at Blackhawk, S. Dak., for 1905.

[Drainage area, 157 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May 9-31	184	66	109	4,972	0.694	0.594
June	51	9	35.4	2,106	.225	.251
July	650	27	210	12,910	1.34	1.54
August	306	34	84.5	5,196	.538	.620
September	34	11	21.6	1,285	.138	.154
October	60	7	19.0	1,168	.121	.140
November	11	2	8.1	482	.052	.058
The period				28,120		

BELLE FOURCHE RIVER AT BELLE FOURCHE, S. DAK.

Belle Fourche River, the largest tributary of the Cheyenne, rises near Middle Butte, in the western part of Weston County, Wyo., flows northeastward to a point near the Wyoming-Montana boundary line, then turns abruptly to the southeast, skirting the northern border of the Black Hills, and unites with the Cheyenne in the southeastern part of Meade County, S. Dak.

The gaging station was established May 26, 1903. It is located at the county highway bridge on the western outskirts of Belle Fourche, S. Dak., in the NW. ¼, sec. 10, T. 8 N., R. 2 E.

The channel is straight for 225 feet above the bridge and 300 feet below. The left bank is high, with a few scattered trees; the right bank is low, sparsely wooded, and subject to overflow at flood stages. The bed of the stream is of gravel and fairly permanent. The water flows in a single channel except at low stages, when it is divided by a gravel bar below the bridge. The current is swift. Gage heights range from 0.5 foot to 11 feet.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is the center of the north pile in the first bent on the east end.

The gage, which was read twice each day during 1905 by Raymond Giles, consists of a vertical timber spiked to a pile on the north side of the bridge on the third bent from the east end. The gage is referred to bench-marks as follows: (1) A spike in a cottonwood tree on the east bank 50 feet below the bridge; elevation, 8.05 feet above the zero of the

gage. (2) The top of the iron breakwater on the east pier of the railroad bridge 300 feet below the highway bridge; elevation, 8.13 feet above the zero of the gage. (3) A United States Geological Survey standard bench mark located in the Butte County court-house yard; elevation, 18.70 feet above the zero of the gage and 3,011.34 feet above sea level, making the elevation of gage datum above sea level 2,992.64 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 57; 130, pp 169-170.
Discharge: 99, p 57; 130, p 170.
Discharge, monthly: 99, p 59; 130, p 172.
Gage heights: 99, p 58; 130, p 171.
Rating table: 99, p 58; 130, p 171.

Discharge measurements of Belle Fourche River at Belle Fourche, S. Dak., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29[a]	F. M. Madden	54	65	1.45	1.80	94
April 13[a]	H. D. Comstock	62	57	1.25	1.68	71
June 1	do	70	89	1.64	2.00	146
Do	do	70	89	1.70	2.00	151
July 5	do	134	414	4.44	4.88	1,838
July 7	do	105	191	3.12	3.19	595
July 21	do	93	143	2.37	2.41	339
Do	do	93	143	2.40	2.41	343
August 2	do	120	261	3.89	3.79	1,015
August 16	J. C. Stevens	131	333	4.30	4.56	1,433

[a] Made by wading.

Daily gage height, in feet, of Belle Fourche River at Belle Fourche, S. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.68	4.25	4.95	1.7	1.58	1.85	1.95	4.85	2.1	1.6	1.7	1.6
2	1.55	5.0	4.35	1.72	2.08	1.9	1.92	3.32	2.1	1.6	1.7	1.6
3	1.35	5.75	3.95	1.65	3.15	1.85	4.3	2.78	2.1	1.6	1.7	.....
4	1.15	6.4	3.4	1.65	3.0	1.8	3.45	3.75	1.75	2.55	1.7	.....
5	.95	6.8	2.8	1.65	2.5	1.75	4.82	3.4	1.7	2.35	1.7	.....
6	.95	7.0	2.85	1.65	2.18	1.7	3.85	3.4	1.58	2.15	1.7	.....
7	.95	7.0	2.25	1.65	2.1	1.7	3.35	3.4	1.5	1.92	1.7	.....
8	1.0	7.0	2.25	1.65	2.18	1.7	3.48	2.15	1.5	1.82	1.7	.....
9	1.02	7.0	2.25	1.72	2.28	1.7	2.75	2.38	1.5	1.72	1.7	.....
10	1.05	6.7	2.25	1.82	2.68	1.75	3.52	3.2	1.45	1.7	1.7	.....
11	1.12	6.45	2.25	1.75	2.38	1.75	2.4	2.35	1.45	1.62	1.7	.....
12	1.3	6.2	2.05	1.7	2.25	1.75	2.6	2.35	1.45	1.65	1.7	.....
13	1.5	6.0	2.0	1.7	2.25	1.75	2.6	2.2	1.52	1.7	1.7	.....
14	1.72	5.9	2.0	1.75	2.2	1.75	2.3	6.38	1.55	1.7	1.7	.....
15	2.05	5.65	2.0	1.75	2.0	3.75	2.1	5.25	1.55	1.7	1.7	.....
16	2.22	5.35	2.0	1.75	1.95	3.15	2.6	4.35	1.55	1.7	1.7	.....
17	2.0	5.3	1.92	1.7	1.85	3.42	2.4	3.18	1.55	1.7	1.65	.....
18	2.0	5.15	1.82	1.7	1.85	.....	2.3	2.72	1.55	1.7	1.65	.....
19	3.0	4.98	1.72	1.7	1.85	2.85	2.05	2.5	1.55	1.7	1.65	.....
20	2.45	4.85	1.65	1.65	1.85	3.65	2.15	2.32	1.55	1.7	1.6	.....
21	2.38	4.8	1.65	1.65	1.85	3.32	2.4	2.2	1.55	1.7	1.6	.....
22	2.15	4.8	1.65	1.65	1.85	3.5	2.45	2.1	1.55	1.7	1.6	.....
23	1.08	4.8	1.6	1.65	1.85	2.85	3.45	2.02	1.55	1.7	1.6	.....
24	2.6	4.72	1.6	1.65	2.0	2.75	3.35	1.95	1.52	1.7	1.6	.....
25	3.0	4.7	1.6	1.65	2.82	2.8	3.35	1.9	1.5	1.7	1.6	.....
26	3.25	4.6	1.6	1.65	3.08	2.8	3.25	1.85	1.5	1.7	1.6	.....
27	3.45	4.6	1.6	1.65	2.38	2.35	4.32	1.8	1.5	1.7	1.6	.....
28	3.55	5.02	1.68	1.65	2.2	2.45	2.35	1.75	1.5	1.7	1.6	.....
29	3.38	.....	1.78	1.65	2.15	3.1	2.5	1.75	1.5	1.7	1.6	.....
30	3.18	.....	1.72	1.65	1.92	3.05	2.25	1.7	1.5	1.7	1.6	.....
31	3.0	.....	1.7	.....	1.9	.....	3.4	2.0	.....	1.7	.....	.....

NOTE.—Ice conditions January 1 to March 6, inclusive.

Station rating table for Belle Fourche River at Belle Fourche, S. Dak., from January 1 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	50	2.50	290	3.60	850	4.70	1,630
1.50	60	2.60	330	3.70	920	4.80	1,705
1.60	75	2.70	370	3.80	990	4.90	1,780
1.70	90	2.80	410	3.90	1,060	5.00	1,855
1.80	110	2.90	450	4.00	1,130	5.20	2,005
1.90	130	3.00	500	4.10	1,200	5.40	2,155
2.00	150	3.10	550	4.20	1,270	5.60	2,305
2.10	175	3.20	610	4.30	1,340	5.80	2,455
2.20	200	3.30	670	4.40	1,410	6.00	2,610
2.30	230	3.40	730	4.50	1,480	6.20	2,770
2.40	260	3.50	790	4.60	1,555	6.40	2,930

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5, and is well defined between gage heights 1 foot and 5.5 feet.

Estimated monthly discharge of Belle Fourche River at Belle Fourche, S. Dak., for 1905.

[Drainage area, 3,250 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 7-31	215	75	127	6,298	0.039	0.036
April	114	78	87.7	5,218	.027	.030
May	580	72	219	13,470	.067	.077
June	955	90	344	20,470	.106	.118
July	1,720	134	531	32,650	.163	.188
August	2,914	90	531	32,650	.163	.188
September	175	55	76.6	4,558	.024	.027
October	310	75	105	6,456	.032	.037
November	90	75	83.7	4,980	.026	.029
The period				126,800		

NOTE.—No estimate for ice period.

REDWATER RIVER AT BELLE FOURCHE, S. DAK.

Redwater River rises in the eastern part of Crook County, Wyo., flows eastward and unites with the Belle Fourche at Belle Fourche, S. Dak.

The gaging station was established July 20, 1903. It is located at the county highway bridge in the eastern limits of Belle Fourche, S. Dak., in the NW. ¼, sec. 11, T. 8 N., R. 2 E., 500 feet above the junction with Belle Fourche River.

The channel is straight for 50 feet above and below the station. The left bank is sufficiently high to prevent overflow, but the right bank is low and subject to overflow; there are trees along both banks. The bed of the stream is rocky and is fairly permanent. There is but one channel except at very high stages, and the current is swift. At very high stages the gage heights may be affected by backwater from Belle Fourche River. There is considerable "dead water" at low stages.

Discharge measurements are made from the north side of the bridge. The initial point for soundings is the center of the pile on the north side and at the east end of the bridge

The gage, which was read twice each day during 1905 by Raymond Giles, consists of a timber spiked to the north pile of the west bent of the bridge. The gage is referred to bench marks as follows: (1) The stone water table at the north corner of the public school building; elevation, 26.05 feet above the zero of the gage. (2) The top of the end of the iron waste pipe projecting from the northeast corner of the public school building; elevation, 22.97 feet above the zero of the gage. (3) The United States Geological Survey standard bench mark in the Butte County court-house yard; elevation, 18.46 feet above the zero of the gage and 3,011.34 feet above sea level, making the elevation of the gage datum above sea level 2,992.88 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 59; 130, pp 172-173.
Discharge: 99, p 59; 130, p 173.
Discharge, monthly: 99, p 60; 130, p 175.
Gage heights: 99, p 60; 130, pp 173-174.
Rating table: 99, p 60; 130, p 174.

Discharge measurements of Redwater River at Belle Fourche, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 30	F. M. Madden	62	150	1.39	2.95	209
April 18	H. D. Comstock	62	152	1.32	2.95	200
May 11	do	65	251	3.76	4.50	945
May 13	do	63	220	3.12	4.05	686
June 9	do	60	111	1.28	2.80	142
July 7	do	62	172	2.22	3.80	382
August 16	J. C. Stevens	62	170	1.52	3.16	258

Daily gage height, in feet, of Redwater River at Belle Fourche, S. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.3	10.0	2.85	2.95	2.9	3.25	3.25	3.4	2.7	2.92	3.5
2	3.3	13.0	2.85	2.95	3.05	3.1	3.25	3.4	2.7	2.95	3.5
3	3.3	13.0	2.85	2.95	3.85	3.15	4.7	3.42	2.7	2.95	3.5
4	3.22	13.0	3.0	2.95	3.82	3.05	4.75	3.35	2.8	2.95	3.5
5	3.15	13.0	2.95	2.95	3.58	3.0	4.2	3.3	2.88	2.95	3.5
6	3.15	13.0	2.85	2.95	3.62	2.95	4.0	3.25	2.95	2.95	3.58
7	3.2	13.0	2.85	2.95	3.42	2.9	3.75	3.25	2.95	2.95	3.6
8	3.25	13.0	2.85	3.0	3.82	2.85	4.28	3.15	2.95	2.95	3.6
9	3.32	13.0	2.85	3.0	4.42	2.85	3.98	3.1	2.95	2.95	3.6
10	3.42	13.0	2.88	3.0	4.82	2.85	3.9	3.1	2.95	2.95	3.6
11	3.55	13.0	2.75	3.0	4.62	2.95	3.7	3.1	2.92	2.95	3.6
12	3.75	13.0	2.85	3.0	4.2	2.95	3.65	3.15	2.85	2.95	3.6
13	4.08	13.0	2.85	3.0	4.15	2.85	3.6	3.2	2.82	2.95	3.6
14	4.95	13.0	2.85	2.95	4.1	2.85	3.65	3.35	2.8	2.95	3.6
15	4.85	11.75	2.85	2.95	4.0	2.85	3.48	3.2	2.85	2.95	3.55
16	5.05	9.5	2.85	2.95	3.88	2.98	3.4	3.2	2.85	3.02	3.55
17	5.18	8.65	2.85	2.95	3.78	3.35	3.4	3.15	2.95	3.32	3.55
18	5.28	8.45	2.85	2.95	3.75	.....	3.4	3.15	2.92	3.5	3.55
19	5.45	8.25	2.85	2.95	3.75	3.5	3.25	3.15	2.9	3.5	3.55
20	5.28	7.35	2.85	2.92	3.72	3.48	3.25	3.08	2.95	3.5	3.6
21	4.9	5.9	2.85	2.9	3.7	3.4	3.75	3.0	2.92	3.5	3.6
22	4.55	4.9	2.85	2.9	3.65	3.4	3.72	2.95	2.9	3.5	3.6
23	4.5	4.5	2.85	2.9	4.0	3.4	3.75	2.95	2.9	3.5	3.6
24	4.65	3.75	2.85	2.9	3.85	3.4	3.5	2.92	2.88	3.5	3.6
25	4.88	3.35	2.9	2.9	3.72	2.9	3.45	2.9	2.85	3.5	3.6
26	5.15	3.05	2.9	2.9	3.65	3.0	3.4	2.85	2.9	3.5	3.6
27	5.32	2.95	2.9	2.9	3.55	3.25	3.7	2.8	2.88	3.5	3.6
28	5.42	2.88	3.0	2.95	3.5	3.0	3.45	2.75	2.85	3.5	3.6
29	5.52	.....	2.95	2.92	3.45	3.25	3.92	2.75	2.85	3.5	3.6
30	5.65	.....	2.95	2.9	3.35	3.25	3.95	2.75	2.9	3.5	3.6
31	5.95	.....	2.95	.....	3.3	.....	3.48	2.7	.....	3.5	.....

NOTE.—Ice conditions January 1 to February 24, inclusive.

Station rating table for Redwater River at Belle Fourche, S. Dak., from January 1 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.70	120	3.30	323	3.90	607	4.50	942
2.80	148	3.40	365	4.00	660	4.60	1,002
2.90	178	3.50	410	4.10	714	4.70	1,064
3.00	210	3.60	457	4.20	769	4.80	1,130
3.10	245	3.70	505	4.30	825	4.90	1,200
3.20	283	3.80	555	4.40	883	5.00	1,265

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905, and is well defined between gage heights 2.7 feet and 4.9 feet.

Estimated monthly discharge of Redwater River at Belle Fourche, S. Dak., for 1905.

[Drainage area, 1,015 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	210	134	171	10,510	0.168	0.194
April	210	178	192	11,420	.189	.211
May	1,144	178	554	34,060	.546	.630
June	410	163	256	15,230	.252	.281
July	1,097	303	520	31,970	.512	.590
August	374	120	247	15,190	.243	.280
September	194	120	170	10,120	.167	.186
October	410	184	296	18,200	.292	.337
November	457	410	445	26,480	.438	.489
The period				173,200		

NOTE.—No estimate for ice period.

SPEARFISH CREEK NEAR SPEARFISH, S. DAK.

Spearfish Creek rises in the Black Hills in western Lawrence County, S. Dak., and flows northward into Redwater River.

The gaging station was established March 30, 1904. It is located at the Chicago, Burlington and Quincy Railroad bridge at Bradley's ranch, 1 mile above Spearfish, S. Dak., in the SW. ¼, sec. 14, T. 6 N., R. 2 E. It replaces the temporary station maintained during a part of 1903 at Toomey's ranch, 6 miles from Spearfish, and was placed at this point to get above the ditches which take water from Spearfish Creek in the town of Spearfish.

The channel is very crooked and the current is swift and full of rapids. Both banks are low, are covered with trees and brush, and overflow only when the stream freezes and the water runs over the ice. The bed is composed of coarse gravel and cobblestones and is not subject to much change. There is but one channel at all stages. Gage heights range from 0.8 foot to 7 feet.

Discharge measurements are made by wading at the gage. In high water they can be made from the bridge to which the gage is attached.

A staff gage, which was read during 1905 once each day by Bessie L. Bradley, is spiked vertically to a pile supporting the bridge near the right bank on the lower side. The gage is referred to bench marks as follows: (1) A drift bolt driven into the base of a cottonwood tree on the right bank, 50 feet below the gage; elevation, 4.02 feet above the zero of the gage. (2) The top of the head of a bolt in a pile in the first bent from the gage; the bolt is

marked by a spike driven through a flaw in the washer; elevation above the zero of the gage, 6.25 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 175–177, 192.

Discharge measurements of Spearfish Creek near Spearfish, S. Dak., in 1905.

Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 6	H. D. Comstock	25	22	3.26	0.96	70
May 16	do	44	54	4.80	1.85	259
June 13	do	31	31	4.16	1.28	129
August 3	do	32	30	4.83	1.24	145
August 26	Stevens and Comstock	34	29	3.72	1.12	108

Daily gage height, in feet, of Spearfish Creek near Spearfish, S. Dak., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.95	1.3	0.85	0.95	1.15	1.25	1.3	1.25	1.1	1.05	1.05	1.05
2	.95	1.5	.85	.95	1.3	1.25	2.02	1.25	1.05	1.05	1.0	1.05
3	.95	2.65	.85	.95	1.3	1.25	2.5	1.25	1.05	1.05	1.0	.....
4	.95	3.05	.85	.9	1.3	1.25	2.05	1.2	1.05	1.05	1.0	.....
5	.9	3.3	.85	.9	1.3	1.35	1.75	1.2	1.05	1.05	1.0	.....
6	.9	3.15	.85	.95	1.3	1.25	1.75	1.2	1.05	1.05	1.0	.....
7	.85	3.4	.85	.95	1.45	1.25	1.65	1.2	1.1	1.05	1.0	.....
8	.85	3.1	.85	.95	1.7	1.25	1.65	1.2	1.1	1.05	1.05	.....
9	.95	2.9	.85	.95	2.25	1.3	1.55	1.2	1.1	1.05	1.05	.....
10	1.05	2.0	.85	.95	2.45	1.3	1.45	1.2	1.05	1.05	1.05	.....
11	2.45	1.0	.85	1.0	2.15	1.3	1.45	1.2	1.05	1.05	1.05	.....
12	2.45	1.0	.85	1.0	2.0	1.3	1.45	1.2	1.05	1.05	1.05	.....
13	2.45	2.0	.85	.95	2.0	1.3	1.4	1.2	1.05	1.05	1.05	.....
14	2.9	3.75	.85	.95	2.0	1.25	1.4	1.2	1.05	1.05	1.05	.....
15	3.7	3.75	.85	.95	1.95	1.25	1.3	1.15	1.05	1.05	1.05	.....
16	3.35	3.75	.85	.95	1.85	1.35	1.25	1.15	1.05	1.05	1.05	.....
17	3.3	3.5	.85	.95	1.75	1.35	1.25	1.15	1.05	1.05	1.05	.....
18	3.2	3.5	.85	.95	1.75	1.45	1.25	1.15	1.05	1.05	1.05	.....
19	3.2	3.5	.85	.95	1.75	1.45	1.25	1.15	1.05	1.05	1.05	.....
20	.85	3.4	.85	.95	1.75	1.45	1.55	1.15	1.05	1.05	1.05	.....
21	.85	3.35	.85	.95	1.75	1.45	1.45	1.15	1.05	1.05	1.05	.....
22	.9	2.85	.85	1.0	1.75	1.45	1.35	1.1	1.05	1.05	1.05	.....
23	.85	.85	.85	1.0	1.6	1.45	1.3	1.1	1.05	1.05	1.05	.....
24	.95	.85	.85	1.05	1.5	1.45	1.3	1.1	1.05	1.05	1.05	.....
25	1.0	.85	.85	1.1	1.5	1.45	1.25	1.1	1.05	1.05	1.05	.....
26	.85	.85	.85	1.15	1.45	1.45	1.25	1.1	1.05	1.05	1.05	.....
27	.85	.85	.85	1.15	1.4	1.45	1.25	1.1	1.05	1.05	1.05	.....
28	.85	.85	.9	1.15	1.4	1.4	1.25	1.1	1.05	1.05	1.05	.....
29	.85	.....	.9	1.15	1.35	1.4	1.25	1.1	1.05	1.05	1.05	.....
30	.65	.....	.95	1.15	1.35	1.35	1.25	1.1	1.05	1.05	1.05	.....
31	.85	.....	.95	.....	1.3	.....	1.25	1.1	.....	1.05	.....	.....

NOTE.—Ice conditions January 1 to February 22, inclusive.

Station rating table for Spearfish Creek near Spearfish, S. Dak., from February 23 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	61	1.40	164	1.80	265	2.20	397
1.00	80	1.50	187	1.90	295	2.30	435
1.10	100	1.60	211	2.00	327	2.40	475
1.20	121	1.70	237	2.10	361	2.50	517
1.30	142						

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904–5, and is not well defined.

Estimated monthly discharge of Spearfish Creek near Spearfish, S. Dak., for 1905

[Drainage area, 230 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
February 23–28	52	52	52.0	619	0.226	0.050
March	70	52	53.7	3,302	.233	.269
April	110	61	79.1	4,707	.344	.384
May	496	110	231	14,200	1.00	1.15
June	176	132	153	9,104	.665	.742
July	517	132	185	11,380	.804	.927
August	132	100	113	6,948	.491	.566
September	100	90	91.3	5,433	.397	.443
October	90	90	90.0	5,534	.391	.451
November	90	80	88.0	5,236	.383	.427
The period				66,460		

NOTE.—No estimate for ice period.

REDWATER CANAL AT MINNESELA, S. DAK.

This station was established May 7, 1904. It is located on the bridge across the canal in the town of Minnesela, 4 miles from Belle Fourche, S. Dak., in sec. 24, T. 8 N., R. 2 E.

The channel is straight for 200 feet above and below the station. The bed is composed of soft mud covered with water grass, which in the late summer lessens the flow of the canal considerably. There is but one channel at all stages, and the current is medium. Water is turned off the canal from about October 20 to May 20, and observations are discontinued during that period. Gage heights range from 1.5 to 3.5 feet.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is a spike in the bridge over the edge of the canal at the right bank, downstream side.

The gage, which was read twice each day during 1905 by Robert H. Mitchell, is a vertical staff fastened to the bridge. The bench mark is a spike in a tree on the left bank about 100 feet from the gage; elevation, 4.00 feet above the zero of the gage.

A description of this station, with gage height and discharge data is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 178-179.

Discharge measurements of Redwater canal at Minnesela, S. Dak., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 30	H. D. Comstock	16	25	1.52	2.51	38
June 9	do	16	31	1.94	2.95	61
July 12	do	16	23	1.07	2.40	25
July 31	do	16	10	.10	1.60	[a] 1

[a] Estimated.

Daily gage height, in feet, of Redwater canal at Minnesela, S. Dak., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.5	2.1	3.0	3.0	2.7	17	.....	0.95	2.5	3.0	2.9	1.9
2	.....	2.65	2.05	3.0	3.0	2.7	18	.....	1.0	2.2	3.0	2.9	1.8
3	.....	2.8	2.0	3.0	3.0	2.7	19	.....	1.3	1.9	3.0	2.95	1.8
4	.....	2.8	2.0	3.0	3.0	2.7	20	.....	2.0	1.9	3.0	2.9	1.8
5	.....	2.8	2.0	3.0	3.0	2.7	21	.....	2.0	1.9	3.0	2.9	1.8
6	.....	2.8	2.0	3.0	3.0	2.7	22	.....	2.0	2.0	3.0	2.75	1.75
7	.....	2.8	2.0	3.2	3.0	2.5	23	.....	2.4	2.5	3.0	2.6	1.7
8	.....	2.85	2.0	3.4	3.0	2.5	24	.....	2.55	2.5	3.0	2.6	.....
9	.....	2.95	2.05	3.4	3.0	2.5	25	.....	2.5	2.25	3.0	2.7	.....
10	.....	3.0	2.45	3.4	3.0	2.5	26	.....	2.4	2.0	3.0	2.7	.....
11	.....	3.0	2.45	3.4	3.0	2.5	27	.....	2.4	2.0	3.0	2.7	.....
12	.....	3.0	2.5	3.4	3.0	2.25	28	.....	2.0	2.95	3.0	2.7	.....
13	.....	3.05	2.5	3.2	3.0	2.0	29	.....	2.0	3.1	3.0	2.7	.....
14	.....	3.2	2.5	3.0	3.0	2.0	30	2.4	2.0	3.0	3.0	2.7	.....
15	.....	3.3	2.45	3.0	2.95	2.0	31	2.42	.....	3.0	3.0	.....	.....
16	.....	2.0	2.5	3.0	2.9	2.0							

Daily discharge, in second-feet, of Redwater canal at Minnesela, S. Dak., 1904–5.

Day.	1904.						1905.					
	May.	June.	July.	Aug.	Sept.	Oct.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	67	30	97	24	29	.....	37	12	60	55	36
2	.....	35	35	97	24	32	.....	46	0	60	55	36
3	.....	9	28	97	24	29	.....	56	9	60	55	36
4	.....	9	44	97	29	26	.....	56	9	60	55	36
5	.....	9	60	97	29	26	.....	51	9	60	55	36
6	.....	9	64	97	29	24	.....	51	9	60	55	36
7	.....	9	64	99	46	24	.....	51	9	74	55	26
8	44	9	64	81	66	24	.....	54	9	89	55	26
9	41	4	64	97	81	18	.....	62	10	89	55	26
10	41	2	64	97	46	16	.....	65	28	89	55	26
11	47	0	64	97	37	4	.....	65	28	89	55	26
12	47	0	64	97	32	.....	.....	65	30	89	55	26
13	38	0	64	97	29	.....	.....	68	30	74	55	7
14	35	0	64	97	26	.....	.....	79	30	60	55	7
15	41	0	64	97	26	.....	.....	87	28	60	52	7
16	38	0	64	81	40	.....	.....	11	30	55	48	7
17	35	0	64	81	34	.....	.....	0	30	55	48	4
18	41	2	60	81	29	.....	.....	0	16	55	48	2
19	41	38	56	70	1	.....	.....	0	6	55	52	2
20	41	47	50	59	1	.....	.....	11	6	55	48	2
21	35	47	60	59	0	.....	.....	11	6	55	48	2
22	53	47	74	59	0	.....	.....	11	9	55	39	1
23	67	44	74	59	5	.....	.....	28	30	55	31	0
24	67	41	67	59	6	.....	.....	36	30	55	31	.....
25	74	47	70	70	6	.....	.....	33	18	55	36	.....
26	74	47	67	81	9	.....	.....	25	9	55	36	.....
27	81	30	32	81	9	.....	.....	25	9	55	36	.....
28	67	30	35	81	10	.....	.....	9	56	55	36	.....
29	67	30	89	77	12	.....	.....	9	67	55	36	.....
30	67	30	89	73	20	.....	32	9	60	55	36	.....
31	67	.....	81	73	.....	.....	33	.....	60	55	.....	.....

NOTE.—The daily discharge is based on a series of parallel curves, each covering a short period of time.

Estimated monthly discharge of Redwater canal at Minnesela, S. Dak., 1904–5.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
May 8-31	81	35	52.0	2,475
June	67	0	21.4	1,273
July	89	28	60.3	3,708
August	97	59	83.3	5,122
September	81	0	24.3	1,446
October 1-11	32	4	22.9	500
The period				14,520
1905.				
June	87	0	37.0	2,202
July	67	6	22.6	1,390
August	89	55	63.0	3,874
September	55	31	47.7	2,838
October 1-23	36	0	18.0	821
The period				11,120

WHITE RIVER DRAINAGE BASIN.

WHITE RIVER AT INTERIOR, S. DAK.

White River rises in the northwestern part of Nebraska, flows northeastward, then eastward, and empties into the Missouri in southeastern Lyman County, S. Dak. The greater part of its course lies through the Bad Lands, which consist of white-clay cliffs and broken bottoms. There is little timber along the river and almost no land under cultivation. The main floods occur in March, May, June, and July.

The gaging station was established June 24, 1904. It is located at the ford about one-fourth mile northeast of Interior, S. Dak., in T. 3 S., R. 18 E.

The channel is curved for about 1,000 feet above and 500 feet below the station. Both banks are high and clean and overflow only at extreme high water. The bed is composed of sand and gravel and is shifting. There is but one channel at all stages except the very lowest, when there may be several channels. The slope at the station is about 3 feet per mile. The current is sluggish at low water. Gage heights range from 1 foot to 16 feet. The stream is frozen from about December 20 to March 10, and observations are discontinued during that period.

Discharge measurements are made by wading at the gage. The initial point for soundings is the top of the inclined gage.

The gage was read once each day during 1905 by George L. Johnson. Originally an inclined gage in two sections was attached to posts set in the bed and left bank of the stream. This gage and bench mark No. 1 were destroyed July 3, 1905. Records were referred to a temporary mark until August 31, 1905, when a new gage was established. It is inclined, consists of three sections, and is graduated to read direct. It is fastened to a post driven in the left bank, and a stump to a post driven near, both about 200 feet above the old gage, and to a post driven in the middle of the channel. Bench mark No. 1 is a spike driven in a blaze on a tree 50 feet above the old gage on the left bank; elevation, 10.26 feet above the zero of the gage. Bench mark No. 2 is a 60-penny spike in a 30-inch tree, blazed, 100 feet northeast of the new high-water gage; elevation, 14.83 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 130 of the United States Geological Survey, pages 181–183.

Discharge measurements of White River at Interior, S. Dak., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 24	H. D. Comstock	112	60	1.47	1.80	88
June 29	do	133	214	2.24	3.06	479
August 31	do	105	59	1.49	2.03	88

Daily gage height, in feet, of White River at Interior, S. Dak., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.0	1.9	2.8	3.75	.....	2.05	1.8	2.1
2	.....	4.1	2.5	5.5	9.2	5.05	1.95	1.8	2.5
3	.....	4.9	4.2	5.3	13.5	4.35	1.95	1.9	2.0
4	.....	3.0	7.5	4.2	.....	4.05	2.3	1.9	2.0
5	.....	2.5	6.5	2.0	.....	3.35	2.25	1.9	2.0
6	.....	2.4	6.3	1.8	.....	3.05	2.15	1.9	2.0
7	.....	2.2	4.8	1.8	.....	2.85	1.95	1.9	2.0
8	.....	2.25	3.4	1.9	4.95	2.35	1.85	1.9	2.0
9	.....	2.2	2.9	1.8	4.65	2.25	1.85	1.9	2.0
10	.....	2.2	2.8	1.65	4.35	2.25	1.9	1.9	2.0
11	.....	2.2	2.5	1.6	5.0	2.15	1.9	1.95	2.0
12	.....	2.0	2.4	1.8	4.95	5.2	1.9	1.95	2.0
13	.....	2.6	2.3	1.6	4.25	5.15	1.9	1.95	2.0
14	.....	2.6	2.1	1.9	3.85	4.35	1.9	2.0	2.0
15	.....	3.5	2.1	2.3	3.05	4.45	1.9	2.0	2.0
16	.....	3.5	2.0	3.0	2.95	4.1	1.9	2.0	2.0
17	.....	3.0	1.9	4.2	2.75	3.95	1.9	1.95	2.0
18	.....	2.8	1.9	16.0	2.45	3.85	1.9	1.9	2.0
19	2.8	2.6	1.8	6.0	2.35	3.65	1.9	2.0	2.0
20	2.7	2.5	1.8	6.0	4.05	3.35	1.9	2.3	2.0
21	2.7	2.4	1.8	5.2	2.95	3.05	1.9	2.2	2.0
22	2.65	2.4	1.7	5.0	5.05	2.65	1.9	2.2	2.0
23	2.65	2.3	1.9	4.7	3.35	2.45	1.9	2.2	2.0
24	2.7	2.0	1.8	4.5	3.15	2.25	1.9	2.1	2.0
25	2.7	2.0	1.9	4.3	2.85	2.25	1.9	2.1	2.0
26	2.9	1.9	1.9	4.2	2.75	2.15	1.8	2.1	2.0
27	2.95	1.9	1.9	3.0	2.65	2.15	1.8	2.1	2.1
28	2.9	1.9	1.9	3.45	4.25	2.15	1.8	2.2	2.2
29	2.95	1.9	5.6	4.05	.....	2.15	1.7	2.2	2.2
30	2.2	1.9	3.3	3.95	.....	2.15	1.7	2.2	2.2
31	2.1	.....	3.0	.....	.....	2.15	.....	2.1	.....

NOTE.—Water over top of gage July 4-7 and July 29 to August 1.

NIOBRARA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Niobrara River rises in the mountains of eastern Wyoming, flows eastward through the northern portion of Nebraska, and empties into the Missouri in Knox County at the city of Niobrara. Its drainage basin is narrow in the upper portion, but broadens considerably near the mouth; it comprises about 9,012 square miles.

Throughout the middle portion of its course the river runs in a deep canyon, varying in depth from 100 to 300 feet. Beyond the canyon are high, rolling, and sometimes broken

table-lands, traversed here and there by deep canyons cut by the numerous tributaries of the river. Large areas of rolling sand hills border these table-lands in portions of Sheridan, Cherry, Brown, Rock, and Holt counties. Formerly these sand hills were very shifting, but within recent years they have become overgrown with a comparatively luxuriant growth of grasses which serves to render them more permanent.

The soil throughout the region is generally sandy, and there is little or no timber except for a few pines on the bluffs of the canyons of the main stream and its tributaries. Lying generally in an east-west direction between the sand hills are extensive hay flats, and on the firmer soils considerable farming is done, for though the annual rainfall is small, most of it occurs during the growing months, and comparatively large quantities of corn, wheat, melons, etc., are produced. By far the greater part of the drainage area of the stream, however, is given over to range land for cattle. The Niobrara Forest Reserve, which lies between Niobrara and Snake rivers, consists almost wholly of sand hills, except along the borders.

Precipitation within the basin varies from 15 to 18 inches in the upper portion, from 18 to 21 inches in the middle portion, and from 21 to 24 inches in the lower portion. Evaporation is 6, 5, and 4½ feet in the upper, middle, and lower portions, respectively. Sixty-nine per cent of the precipitation falls during April, May, June, July, and August, and about one-half of the remainder is snowfall.

The river is not subject to periodic rises of any extent, owing to the fact that the sand hills which form so large a portion of its drainage area act as storage reservoirs for the rain and snow, which are afterwards fed to the stream in the form of spring water, thus equalizing the flow and making the constancy of the discharge almost phenomenal.

In the southern part of Cherry County are numerous small lakes which form the headwaters of tributaries. These lakes are subject to slight periodic rises which lag considerably behind the periods of greatest rainfall, and on one of them, Red Deer Lake, a gaging station was established in order that this characteristic might be studied.

The principal tributaries are Verdigris, Keya Paha, and Snake rivers, and Minnechaduza Creek. The drainage area of the Snake is similar in nearly all respects to that of the western part of the Niobrara.

The water resources of the Niobrara are at present almost wholly undeveloped, irrigation being limited to the low, narrow flood plains in the bottoms of the canyons. On Minnechaduza Creek, at Valentine, an artificial lake has been formed by a dam, and a power plant has been installed for lighting and for furnishing the city with water. On the lower portion of the Niobrara a number of mills are in operation, receiving their power from small tributaries. On Snake River possibilities for power development are phenomenal, but long transmission lines would be required to make it of practical value.

Detailed information in regard to this drainage basin is contained in the following reports:

A reconnaissance of Niobrara River and its tributaries, by J. C. Stevens: Third Ann. Rept. U. S. Reel. Service (2d ed.), 1905, pp. 338 et seq.

Preliminary report on the geology and water resources of Nebraska west of the 103d meridian, by N. H. Darton: Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1898, pp. 719 et seq.

NIOBRARA RIVER NEAR VALENTINE, NEBR.

This station was established July 22, 1897, and was known as the Fort Niobrara station. June 26, 1901, it was moved about 3 miles farther upstream to the Borman Bridge, in sec. 4, T. 34, R. 28, about 3 miles southeast of the town of Valentine.

At the gaging station the stream lies on an easy curve. The banks are heavily wooded and high and are not liable to overflow. The bed is composed of cobblestones and sand, which at times of high water scours out, leaving the rocks comparatively bare. The shifting of the sand renders the development of a good rating curve a difficult matter, and the method of applying a rating table indirectly has been largely used. There are no natural obstructions in the stream and the current is always swift. The range of gage heights seldom exceeds 2 feet except in the case of a "cloudburst," when the very lowest bottom

land has been flooded for a few hours. The river seldom freezes completely over, and during 1904 and 1905 records of gage heights were obtained throughout the winter.

Discharge measurements are made from a single-span steel bridge. The initial point for soundings is the zero mark on the upstream hand rail in line with the west face of the east pier.

The gage, which is observed by John Borman, is of the wire and weight type, and is located about 1,000 feet upstream from the bridge on the left bank. The length of the wire is 9.90 feet. The gage is referred to bench marks as follows: (1) The head of a nail driven in the stump of a boxelder tree—one of a clump of four—just east of Mr. Borman's house; elevation above the zero of the gage, 17.26 feet. (2) A 2 by 6 inch pine head block, on which the gate of Borman's fence rests when closed; elevation above the zero of the gage, 16.19 feet. As a check, the elevation of the water surface at the time of making the measurements is referred to the bottom of the upstream end of the second floor beam from the end of the bridge on the left bank.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, p 255; WS 66, p 25; 84, p 18; 99, p 46; 130, pp 183-184.
Discharge: Ann 18, iv, p 193; 20, iv, pp 255, 301; WS 66, p 25; 84, p 18; 99, p 46; 130, p 184.
Discharge, daily: WS 130, p 185.
Discharge, monthly: WS 84, p 20; 99, p 48; 130, p 186.
Gage heights: WS 66, p 25; 84, p 19; 99, p 47; 130, p 184.
Rating tables: WS 84, p 19; 99, p 47.

Discharge measurements of Niobrara River near Valentine, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 13	E. L. Thomas	117	220	4.13	1.64	910
May 31	H. C. Gardner	120	253	4.51	1.85	1,142
June 29	do	120	227	4.89	1.80	1,111
July 19	G. W. Bates	120	203	4.06	1.50	818
August 15	H. C. Gardner	105	204	4.78	1.65	978
October 15	do	120	228	3.65	1.55	834
November 15	G. W. Bates	115	207	4.28	1.65	886
December 27	do	110	208	4.53	1.75	940

Daily gage height, in feet, of Niobrara River near Valentine, Nebr., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.15	2.78	2.3	1.65	1.53	1.76	1.76	1.88	1.48	1.45	1.57	1.95
2	1.9	2.8	2.15	1.8	1.55	1.75	3.15	1.82	1.5	1.43	1.6	1.35
3	2.15	3.35	2.0	1.78	1.62	1.86	2.8	1.75	1.45	1.47	1.56	1.23
4	2.03	3.6	1.78	1.8	2.03	1.68	2 4	1.7	1.44	1.45	1.59	1.37
5	2.05	3.77	1.75	1.71	1.8	1.65	2.32	1.67	1.48	1.5	1.62	2.18
6	2.02	3.9	1.8	1.65	1.75	1.5	2.15	1.68	1.45	1.52	1.57	2.2
7	2.0	3.85	1.78	1.6	1.68	1.48	2.05	1.65	1.49	1.49	1.59	2.1
8	2.03	3.7	1.75	1.62	1.65	1.5	1.82	1.67	1.53	1.55	1.61	2.15
9	1.9	3.6	1.7	1.6	1.6	1.55	1.93	1.66	1.55	1.57	1.59	2.2
10	2.07	3.67	1.64	1.82	1.63	1.75	1.85	1.58	1.5	1.53	1.58	2.03
11	2.45	3.95	1.62	1.68	1.7	1.7	1.8	1.55	1.47	1.45	1.61	2.0
12	3.2	4.0	1.6	1.57	1.63	1.55	1.68	1.55	1.45	1.44	1.6	1.98
13	3.6	3.9	1.64	1.55	1.55	1.58	1.65	1.58	1.42	1.45	1.59	2.0
14	3.15	3.9	1.60	1.62	1.64	1.56	1.6	1.72	1 5	1.5	1.63	1.9
15	3.9	3.65	1.63	1.7	1.6	1.55	1.62	1.64	1.49	1.55	1.64	1.9
16	3.85	3.6	1.67	1.66	1.65	1.6	1.65	1.6	1.52	1.48	1.6	1.92
17	3.15	3.35	1.66	1.65	1.53	1.57	1.68	1.55	1.47	1.48	1.63	1.88
18	3.2	3.55	1.73	1.6	1.5	1.93	1.57	1.53	1.55	1.49	1.65	1.75
19	2.77	3.38	1.7	1.57	1.53	1.75	2.48	1.51	1.48	1.55	1.65	1.76
20	2.5	3.16	1.62	1.55	1.52	1.95	2.15	1.48	1.45	1.5	1.66	1.78
21	2.2	3.1	1.65	1.53	1.52	1.6	1.95	1.5	1.45	1.52	1.67	1.75
22	2.38	3.18	1.63	1.54	1.53	1.77	1.76	1.53	1.47	1.5	1.7	1.75
23	2.33	2.85	1.7	1.53	1.5	1.63	1.75	1.5	1.5	1.48	1.72	1.69
24	2.45	2.74	1.68	1.67	1.48	1.78	1.6	1.5	1,45	1.49	1.74	1.65
25	2.83	2.6	1.65	1.68	1.52	2.04	1.73	1.45	1.42	1.5	1.73	1.63
26	2.25	3.0	1.6	1.73	1.53	1.8	1.62	1.42	1.5	1.5	1.7	1.75
27	2.33	2.7	1.62	1.6	1.78	2.5	1.6	1.45	1.52	1.53	1.75	1.72
28	2.57	2.48	1.75	1.6	1.65	1.95	1.6	1.43	1.45	1.54	1.77	1.65
29	2.85	.....	1.65	1.55	2.2	1.72	1 61	1.49	1.5	1.58	1.56	1.58
30	1.9	.....	1.58	1.5	1.95	1.85	1.87	1.45	1.47	1.56	1.35	1.7
31	2.0	.....	1.61	.....	1.85	.....	1.8	1.48	.....	1.59	.....	1.56

Daily discharge, in second-feet, of Niobrara River near Valentine, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	905	740	1,005	1,065	1,375	760	725	820
2	.....	1,125	760	990	3,420	1,270	785	705	855
3	.....	1,095	835	1,160	2,845	1,150	730	745	805
4	.....	1,125	1,480	895	2,165	1,070	720	725	835
5	1,070	985	1,090	860	2,044	1,025	760	780	870
6	1,150	900	1,015	695	1,755	1,040	730	800	810
7	1,120	835	910	680	1,600	990	770	765	830
8	1,070	860	870	700	1,210	1,015	815	835	850
9	995	835	810	750	1,400	1,005	840	855	825
10	910	1,150	845	1,005	1,280	990	780	810	815
11	880	935	935	935	1,200	850	750	725	845
12	860	795	845	750	1,020	850	730	715	830
13	910	775	750	785	980	885	700	725	815
14	860	855	855	765	915	1,085	780	775	865
15	895	960	805	755	950	930	770	834	880
16	950	905	865	815	1,000	905	805	750	825
17	935	890	730	780	1,055	845	750	750	860
18	1,035	825	700	1,310	900	820	840	760	880
19	990	790	725	1,020	2,420	795	760	825	880
20	880	770	715	1,345	1,855	765	725	765	890
21	915	745	715	820	1,515	785	725	785	900
22	890	755	725	1,055	1,190	820	750	760	940
23	985	745	695	860	1,170	785	780	740	965
24	955	910	675	1,075	940	785	725	750	995
25	910	925	710	1,515	1,135	730	700	755	980
26	845	995	720	1,110	965	700	780	755	935
27	870	820	1,035	2,300	935	730	800	785	1,005
28	1,055	820	855	1,365	935	710	725	795	1,030
29	910	760	1,740	990	1,005	770	780	840	760
30	820	710	1,310	1,200	1,365	730	745	815	575
31	855	.....	1,140	.....	1,240	760	.....	845	.....

NOTE.—The daily discharge was obtained by the indirect method. Owing to the uncertainty of ice conditions and lack of high-water measurements no estimate was made January 1 to March 4 nor December 1–31.

Estimated monthly discharge of Niobrara River near Valentine, Nebr., for 1905.

[Drainage area, 6,070 square miles.]

Month.	Discharge in second-feet.			Run-off.		
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
March 5–31	1,150	820	945	50,610	0.156	0.157
April	1,150	710	883	52,540	.145	.162
May	1,740	675	890	54,720	.147	.170
June	2,300	680	1,010	60,100	.166	.185
July	3,420	900	1,402	86,200	.231	.266
August	1,375	700	902	55,460	.149	.172
September	840	700	760	45,220	.125	.140
October	855	705	774	47,590	.128	.148
November	1,030	575	866	51,530	.143	.160
The period	.....	.....	.....	504,000	.....	.....

RED DEER LAKE NEAR WOODLAKE, NEBR.

This station was established August 12, 1904. The lake is located in secs. 16, 17, 20, and 21, T. 30 N., R. 27 W., about 16 miles south of Woodlake post-office and about 30 miles south of Valentine, Nebr., and is representative of the numerous lakes of this region. The station was established for the purpose of determining the cause and amount of the periodic rise of these lakes, which, according to local authorities, is often several feet, beginning in April or May.

The lake covers about 1 square mile of surface and is merely a valley or flat in the sand hills, filled with water. The depth varies from 1 foot to 15 feet, the average being probably about 8 feet. The bed is entirely of sand, and the margin is thickly grown with rushes, etc.

The gage was observed by J. S. Brosius. It consists of a staff fastened to a post at the end of the boat landing 200 yards south of Cochran's ranch house near the east end of the lake. The bench mark is a group of three spikes driven horizontally near the base of a cottonwood tree 12 inches in diameter, located 40 feet south and 20 feet east of the southwest corner post of the large windmill tower just west of Cochran's house; elevation above the zero of the gage, 9.61 feet.

The station was discontinued October 31, 1905.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper of the United States Geological Survey No. 130, pages 186-187.

Daily gage height, in feet, of Red Deer Lake near Woodlake, Nebr., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1				4.39			4.75			
2									4.3	
3		4.46	4.36			4.55				
5					4.49			4.71		
6	4.4									
7				4.43						4.16
8							4.82			
9									4.32	
10			4.29			4.62				
11		4.5								
12								4.59		
13					4.52					
14	4.41						4.72			4.23
15				4.4						
16									4.3	
17		4.49	4.35			4.6				
19								4.5		
20	4.4				4.41					
21				4.36						
22							4.68			4.24
23									4.3	
24						4.7				
25		4.44	4.3							
26								4.4		
27					4.52					
28	4.41									
29				4.4			4.65			4.3
30									4.2	

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements made in Niobrara River drainage basin, Nebraska, in 1905.

Date.	Stream.	Locality.	Area of section.	Mean velocity.	Discharge.
			Sq. ft.	*Ft. per sec.*	*Sec.-ft.*
April 26	South Fork of Eagle Creek	Sec. 9, T. 30 N., R. 13 W	15	1.66	25
April 26	North Fork of Eagle Creek	Sec. 26, T. 31 N., R. 13 W	4.3	1.88	8.1
April 27	Beaver Creek	Sec. 19, T. 32 N., R. 16 W	18	1.12	20
July 18	Keya Paha River		58	2.34	136

PLATTE RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Considered only with regard to the extent of area drained, the Platte is the most important tributary of the Missouri. It is formed by two forks, North Platte and South Platte, which rise, respectively, in northern and in central Colorado and unite a little southwest of the center of Nebraska. Its entire drainage basin comprises about 90,000 square miles, of which in round numbers 36,000 square miles belong to the North Platte and 24,000 to the South Platte. The lower course of the river is fairly well settled, but farther west the population is more scattered.

For convenience the description of the basin is divided, and the North Platte, South Platte, and Platte River proper are considered separately.

NORTH PLATTE RIVER.

DESCRIPTION OF BASIN.

The source of the North Platte is in North Park, Colorado, or rather in the mountains which, rising to elevations from 4,000 to 5,000 feet above its general level, hem it in on all sides. From the steep slopes of these mountains numerous small streams descend, unite below into large creeks, and flow outward to the center of the basin. The two which may be said to form the real head of the North Platte are Grizzly and Little Grizzly creeks, but within the park the river is joined by four large tributaries, Roaring Fork and North Fork from the west and Michigan and Canadian creeks from the east. Leaving the park, the river makes a bold curve northward into Wyoming, but near Caspar, on the north side of the Caspar Range, it turns abruptly to the east and southeast, maintaining the latter course to its point of junction with the South Platte in central Nebraska.

Within North Park the topographic features are diversified, including every degree of roughness from the snow-capped peaks of the Park and Medicine Bow ranges to the level prairie mesas along the lower portion of the stream. Dense forests occur in the mountain tracts, the heaviest being those on the east slope of the Park and the west slope of the Medicine Bow ranges. At an elevation of 8,500 feet above sea level the forests give way to the open prairie country, which, with the exception of the dense growth of willows along the river bottoms, is entirely free from forests of any description. The soil, composed principally of gravelly and sandy loam on the mesas and of sandy and black loam along the river bottoms, is in general fertile, but climatic conditions are such that the agricultural products are limited to wild hay, roots, and a few of the hardier grains.

In its northward course through Wyoming the stream receives many tributaries, the Snowy Range on the east contributing its drainage through Douglas, French, and Brush creeks, while the northeast slope of the Sierra Madre is drained by Beaver, Big Cow, and Spring creeks and Grand Encampment River. Medicine Bow and Sweetwater rivers are

added to the North Platte between Saratoga and Caspar, beyond which the only important tributary is the Laramie, which enters at old Fort Laramie.

The greater part of the region below Saratoga is a rolling, undulating prairie. The soil throughout Wyoming is a sandy loam of sufficient depth to produce meadows of rich grasses, even up to elevations of 7,000 feet. At lower elevations the soil becomes more friable and deeper.

Throughout its course in western Nebraska the valley of the North Platte is 10 to 15 miles wide. The present floor, consisting of sediments deposited in a former greater valley, is bordered by terraces and table-lands scarred by numerous tributaries and arroyos. The stream is broad and shallow, with a flood plain from 1 mile to 4 miles wide.

The character of the river bed at the Big Bend and at the Seminole Mountains, in Wyoming, seems to indicate a considerable underflow. A part of this is collected at the Big Bend, and probably the entire amount is brought to the surface as the river passes through the Seminole Range. In its lower course the bed of the stream is of fine quicksand, underlain at a depth of from 15 to 20 feet by a hard layer which seems to be clay.

Agricultural efforts in the basin of the North Platte have been largely confined to the valleys of the tributaries. No important work has been undertaken except on the Laramie, and this on the plains before that stream has passed through the Laramie Mountains and received the drainage of their eastern slope. On tributaries of the North Platte, however, the available lands are all occupied over the entire basin.

The stream is subject to periodic floods, which reach their maximum at the mouth some time during the latter part of June and are caused by the melting snow on the high ranges in which the headwater streams rise. The river runs lowest in winter, when it freezes thickly. High water prevails from the middle of April to the middle of July, when the river runs bank full.

In the mountain districts the precipitation, which is mostly in the form of snow during the winter and spring months, varies from 7 to 15 inches, the average being about 11 inches. Throughout the lower portion of the basin the precipitation is from 15 to 18 inches and the evaporation from water surface is from 5 to 6 feet.

Information in regard to the basin is contained in the Annual Reports of the Reclamation Service and in the Annual Reports of the United States Geological Survey, as follows: Thirteenth, pt. 3, pp. 78–82; Nineteenth, pt. 4, pp. 304–306, 772–774; Twenty-second, pt. 4, pp. 310–311.

GRIZZLY CREEK AT HEBRON, COLO.

Grizzly Creek rises on the northern slope of the Continental Divide in North Park, Colorado, flows northward, and unites with Little Grizzly Creek to form the North Platte. Its principal tributaries are Colorado, Arapahoe, and Buffalo creeks.

The gaging station was established May 13, 1904. It is located at the highway bridge at Hebron, Colo., about 2 miles above the junction with Little Grizzly Creek and 10 miles from Walden, Colo., in sec. 29, T. 8 N., R. 80 W.

The channel is straight for about 50 feet above and below the station. The banks are about 3 feet high and neither is liable to overflow. The current is at a right angle to the gaging section and is uniform and medium at all stages. The bed of the stream is composed of gravel, with cobblestones and mud on the left side. There is but one channel at all stages. Gage heights have a range of about 3 feet. The stream is frozen over during the greater part of the winter season, making gage readings impossible.

At very high stages discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is the face of the left abutment at the zero marked on the hand rail. At low and ordinary stages discharge measurements are made by wading near the gage.

The gage, which is read once each day by James Peterson, is a vertical staff graduated from 2 to 9.5 feet spiked to the left downstream corner of the middle crib pier. The 2-foot mark rests on the bed of the stream. The gage is referred to bench marks as follows: (1) A 30-penny nail driven vertically into the top of the downstream end of the top timber

of the left abutment of the bridge; elevation, 9.76 feet above the zero of the gage. (2) A regulation iron bench-mark post 4 feet east of the fence on the west side of the road, 60 feet south of the river bank; elevation, 8.82 feet above the zero of the gage. The elevation above sea level is approximately 8,100 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 53–55.

Discharge measurements of Grizzly Creek at Hebron, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 17	W. A. Lamb	54	173	1.73	5.70	299
June 17	do	53	76	2.71	.....	206
June 25	do	30	29	2.28	4.30	66
July 14	do	17	8.8	1.28	3.62	11
August 9	do	15	5.8	.86	3.50	5
August 24	do	8	1.7	.29	3.26	.5
September 26	do	9	2.5	.84	3.40	2.1

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Grizzly Creek at Hebron, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	5.35	5.55	3.9	3.5	3.3	3.3
2	.....	5.65	5.7	3.9	3.55	3.3	3.2
3	.....	5.55	5.75	3.98	3.6	3.45	3.45
4	.....	5.3	5.88	3.98	3.58	3.45	3.45
5	.....	5.02	5.9	3.98	3.6	3.45	3.45
6	.....	4.95	5.92	3.9	3.55	3.45	3.45
7	.....	4.7	5.75	4.0	3.55	3.45	3.45
8	.....	4.45	5.55	4.1	3.5	3.45	3.45
9	.....	5.95	5.8	4.18	3.5	3.45	3.45
10	.....	5.25	5.78	4.15	3.5	3.4	3.45
11	.....	4.9	5.95	4.22	3.5	3.4	3.45
12	.....	4.5	5.82	4.48	3.5	3.35	3.45
13	.....	4.55	5.7	4.5	3.5	3.35	3.45
14	.....	4.9	5.45	4.4	3.5	3.3	3.45
15	.....	4.8	5.55	4.38	3.5	3.3	3.45
16	.....	5.12	5.6	4.45	3.4	3.3	3.48
17	4.2	5.52	5.68	4.45	3.4	3.3	3.5
18	4.25	5.35	5.45	4.25	3.3	3.3	3.5
19	4.68	5.65	5.05	3.85	3.3	3.3	3.5
20	4.38	5.35	5.0	3.5	3.32	3.3	3.5
21	4.3	5.7	5.1	3.5	3.3	3.3	3.5
22	4.32	5.95	5.0	3.48	3.25	3.3	3.5
23	4.3	5.7	4.95	3.48	3.25	3.3	3.5
24	4.2	5.7	4.85	3.48	3.2	3.3	3.5
25	4.28	5.6	4.45	3.5	3.2	3.3	3.45
26	4.5	5.55	4.38	3.4	3.2	3.3	3.45
27	5.55	5.5	4.2	3.45	3.2	3.3	3.45
28	5.12	5.6	4.05	3.5	3.2	3.35	3.45
29	4.8	5.4	3.95	3.5	3.3	3.35	3.45
30	5.15	5.55	3.9	3.5	3.5	3.35	3.48
31	.....	5.5	.....	3.5	3.3	.....	3.48

Station rating table for Grizzly Creek at Hebron, Colo., from April 17 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
3.20	1	4.00	35	4.80	131	5.60	281
3.30	2	4.10	43	4.90	147	5.70	303
3.40	4	4.20	52	5.00	164	5.80	325
3.50	7	4.30	62	5.10	182	5.90	347
3.60	11	4.40	74	5.20	200	6.00	370
3.70	16	4.50	87	5.30	219		
3.80	22	4.60	101	5.40	239		
3.90	28	4.70	116	5.50	260		

The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904-5, and is well defined between gage heights 3.3 and 5.6 feet.

Estimated monthly discharge of Grizzly Creek at Hebron, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April (14 days)	270	52	104	2,888
May	358	80	227	13,960
June	358	28	226	13,450
July	87	4	34.0	2,091
August	11	1	5.1	314
September	6	2	3.1	184
October	7	1	5.7	350
The period				33,240

LITTLE GRIZZLY CREEK AT HEBRON, COLO.

Little Grizzly Creek rises on the eastern slope of the Park Range in North Park, Colorado, flows eastward and unites with Grizzly Creek to form the North Platte.

The gaging station was established June 3, 1904. It is located at the wagon bridge on James Hill's ranch, one-half mile southwest of Hebron, Colo., and one-fourth mile west of the road from Hebron to Spicer, in sec. 32, T. 8 N., R. 80 W.

The channel is straight for 150 feet above and below the station. Both banks are low and liable to overflow. The bed of the stream is composed of gravel and small cobblestones and is firm. There is but one channel at all stages, broken by the middle pier of the bridge, and the current has a medium and uniform velocity. Gage heights have a range of about 3 feet. The creek is frozen over during the greater part of the winter.

High-water discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is on the east edge of the pier at the left bank of the stream. Low-water measurements are made by wading 300 feet above the gage.

The gage is read once each day by John Peterson, who lives one-half mile distant. It is a staff nailed vertically to the northwest corner of the center pier of the bridge. The gage is referred to bench marks as follows: (1) A nail driven into the north end of the second log of the west abutment; elevation above the zero of the gage, 5.90 feet. (2) A nail driven into the north end of a log in the right abutment; elevation above the zero of the gage, 6.37 feet. (3) Top of regulation iron bench-mark post 80 feet east and 20 feet north of the gage; elevation above the zero of the gage, 6.79 feet. The elevation is approximately 8,100 feet above sea level.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 55–57.

Discharge measurements of Little Grizzly Creek at Hebron, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 17	W. A. Lamb	38	87	1.95	4.15	170
June 17	do	44	142	3.00	5.45	426
June 25	do	38	117	2.74	4.75	321
July 14	do	22	34	1.41	3.20	48
August 9	do	28	14	1.14	2.83	16
August 24	do	18	21	.33	2.68	6.9
September 26	do	18	54	.87	2.68	4.7

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Little Grizzly Creek at Hebron, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	4.25	4.55	3.95	2.9	2.6	2.8
2	.....	4.25	5.05	4.88	2.95	2.6	2.85
3	.....	4.25	5.15	4.88	2.82	2.6	2.82
4	.....	3.9	5.48	4.9	2.88	2.6	2.8
5	.....	3.88	5.45	4.95	2.92	2.6	2.8
6	.....	3.82	5.6	5.0	2.85	2.6	2.8
7	.....	3.65	5.45	4.88	2.85	2.6	2.8
8	.....	4.05	5.45	4.85	2.85	2.6	2.8
9	.....	3.4	5.55	4.82	2.85	2.6	2.8
10	.....	4.1	5.55	4.78	2.85	2.62	2.8
11	.....	3.5	5.92	4.78	2.85	2.65	2.8
12	.....	3.75	5.65	4.1	2.85	2.65	2.8
13	.....	3.6	5.45	3.3	2.85	2.65	2.8
14	.....	3.65	5.45	3.45	2.75	2.65	2.8
15	.....	3.65	5.4	3.55	2.65	2.65	2.82
16	.....	3.7	5.5	3.45	2.62	2.65	2.85
17	3.25	4.15	5.6	3.2	2.5	2.65	2.9
18	3.08	4.05	5.4	3.32	2.55	2.65	2.9
19	3.12	3.9	5.42	3.15	2.6	2.65	2.9
20	3.38	4.0	5.42	2.9	2.68	2.65	2.9
21	3.52	4.0	5.35	3.1	2.65	2.65	2.9
22	2.78	4.4	5.35	3.12	2.65	2.65	2.9
23	3.15	4.95	4.85	3.1	2.65	2.65	2.9
24	3.25	4.95	4.55	2.95	2.82	2.67	2.9
25	3.2	4.95	4.48	3.0	2.7	2.68	2.9
26	3.2	4.95	4.5	2.9	2.7	2.75	2.9
27	3.3	4.7	4.6	2.9	2.8	2.75	2.9
28	3.88	4.7	4.65	3.0	2.7	2.75	2.9
29	3.85	4.55	4.55	3.0	2.6	2.78	2.9
30	3.98	4.35	4.52	3.1	2.6	2.82	3.0
31	.....	4.8	.....	3.0	2.6	.....	3.0

Station rating table for Little Grizzly Creek at Hebron, Colo., from April 17 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.50	1	3.40	71	4.30	196	5.20	396
2.60	4	3.50	83	4.40	215	5.30	422
2.70	9	3.60	95	4.50	235	5.40	448
2.80	15	3.70	108	4.60	255	5.50	475
2.90	22	3.80	121	4.70	276	5.60	502
3.00	30	3.90	134	4.80	298	5.70	530
3.10	39	4.00	148	4.90	321	5.80	558
3.20	49	4.10	163	5.00	345	5.90	586
3.30	60	4.20	179	5.10	370	6.00	615

The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904-5 and is fairly well defined between gage heights 2.7 feet and 5 feet.

Estimated monthly discharge of Little Grizzly Creek at Hebron, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17-30	145	14	68.6	1,905
May	333	71	182	11,190
June	592	231	401	23,860
July	345	22	138	8,485
August	26	1	12.3	756
September	16	4	6.9	411
October	30	15	19.2	1,181
The period				47,790

ROARING FORK OF NORTH PLATTE RIVER NEAR HEBRON, COLO.

Roaring Fork rises in the Park Range at the crest of the Continental Divide, flows eastward, and enters the North Platte about 3 miles below the junction of Grizzly and Little Grizzly creeks. The basin is very rugged, a large portion extending above the timber line and reaching an altitude of 13,000 feet above sea level. The headwaters consist of a number of branches, occupying small valleys separated by high, precipitous hills, and deriving their water supply from banks of perpetual snow and ice. The valley of the main stream is narrow, varying in width from a few hundred feet to half a mile, with bluffs on each side bounded by high, rolling mesa lands. The soil on the first bottom consists of black sandy loam and is generally very fertile. That on the mesas is of gravel and sandy loam. The forests about the headwaters comprise a heavy growth of white pine and spruce timber, with an abundance of underbrush and shrubbery. The bottom and first mesa land near the mouth are under cultivation, hay being practically the only crop.

The gaging station was established May 14, 1904. It is located at the highway bridge about 2 miles above J. E. Mallan's ranch house, 4 miles west of Hebron, Colo., and one-half mile above the mouth of the fork, in sec. 11, T. 8 N., R. 81 W.

The channel is straight for about 100 feet above and 50 feet below the station. The banks, which are about 5 feet high above and 3 feet high below the bridge, are lined with willows, and are not liable to overflow except at extremely high stages. The bed of the stream is composed of coarse gravel and cobblestones and is uniform and stable. There is but

one channel at all stages and the current is uniform and moderately swift. During an ordinary season gage heights have a range of about 3 feet. In the winter months the channel is obstructed by ice, and gage readings are unreliable.

Discharge measurements are made from the single-span bridge to which the gage is attached. The initial point for soundings is the south face of the north abutment, and is marked by a spike driven in the bridge floor. Low-water measurements are made by wading near the gage.

The gage was read twice each day during 1905 by Mrs. Stella Bohn, who lives 200 yards west of the station. A standard chain gage was established June 14, 1904. It is located on the east side of the bridge, 18 feet from the south face of the north abutment. The length of the chain is 7.70 feet. The gage is referred to bench marks as follows: (1) The top of a spike driven horizontally into the east end of the second timber from the top of the north abutment; elevation above gage datum, 2.86 feet. The head of a nail driven vertically into the north end of the gage rod is 2.55 feet above this bench mark. (2) Top of cast-iron rod 16 inches long, 1 inch square at the lower end and tapering to a point at the upper end, set on a bowlder sunk in the ground by the side of the lane fence, 50 feet northeast of the north pier of the bridge; elevation above gage datum, 7.14 feet. The elevation above sea level is approximately 8,100 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 55–59.

Discharge measurements of Roaring Fork of North Platte River near Hebron, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 18	W. A. Lamb	24	22	1.77	1.63	39
June 18	do	41	81	4.58	3.59	371
June 24	do	41	75	4.44	3.30	333
July 15	do	34	38	2.34	2.02	89
August 8	do	25	24	1.71	1.70	41
August 23	do	20	17	1.29	1.48	22
September 25	do	15	7.4	1.07	1.25	7.9

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Roaring Fork of North Platte River near Hebron, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		1.35	2.35	2.55	1.88	1.35	1.25
2			2.65	2.48	1.85	1.3	1.25
3			3.02	2.4	1.85	1.3	1.25
4		1.4	3.65	2.25	1.78	1.3	1.25
5			3.82	2.02	1.72	1.3	1.25
6		1.4	3.45	1.98	1.7	1.3	1.25
7			3.35	2.02	1.72	1.3	1.25
8		1.35	3.7	2.08	1.7	1.3	1.25
9			3.92	2.08	1.7	1.25	1.25
10		1.35	3.7	1.95	1.65	1.25	1.2
11			3.38	1.9	1.65	1.25	1.2
12			3.28	1.92	1.65	1.25	1.2
13		1.35	3.38	2.15	1.62	1.25	1.25
14			3.42	2.0	1.58	1.2	1.25
15		1.1	3.52	2.08	1.52	1.2	1.3
16			3.65	2.15	1.5	1.2	1.28
17	1.5		3.52	2.1	1.5	1.2	1.2
18		1.62	3.45	1.98	1.5	1.25	1.25
19		1.72	3.3	1.98	1.45	1.25	1.25
20	1.6	1.65	3.22	1.92	1.45	1.25	1.32
21		1.8	3.3	1.98	1.45	1.25	1.35
22	1.4	1.9	3.3	1.9	1.45	1.25	1.4
23		2.05	3.55	1.98	1.48	1.25	1.48
24	1.3	2.08	3.8	1.8	1.4	1.25	1.48
25		2.1	3.25	1.8	1.4	1.25	1.45
26	1.2	2.08	3.25	1.8	1.35	1.25	1.45
27		2.12	3.12	1.9	1.35	1.2	1.48
28		2.12	2.98	1.82	1.35	1.2	1.45
29	1.4	2.08	2.8	1.95	1.35	1.2	1.48
30		1.98	2.65	1.92	1.35	1.25	1.48
31		2.02		1.92	1.35		1.45

Station rating table for Roaring Fork of North Platte River near Hebron, Colo., from April 17 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	4	1.90	71	2.70	205	3.40	342
1.20	7	2.00	85	2.80	224	3.50	362
1.30	11	2.10	100	2.90	243	3.60	383
1.40	17	2.20	116	3.00	262	3.70	404
1.50	24	2.30	133	3.10	282	3.80	425
1.60	33	2.40	150	3.20	302	3.90	446
1.70	44	2.50	168	3.30	322	4.00	467
1.80	57	2.60	186				

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905, and is not well defined.

Estimated monthly discharge of Roaring Fork of North Platte River near Hebron, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17-30 [a]	33	7	17.6	489
May	103	4	43.6	2,681
June	450	142	327	19,460
July	177	57	89.5	5,503
August	68	14	31.5	1,937
September	14	7	9.2	547
October	23	7	13.0	799
The period				31,420

[a] Missing gage heights interpolated.

NORTH FORK OF NORTH PLATTE RIVER AT HIGHO, COLO.

North Fork of North Platte River rises in the Park Range near the Colorado-Wyoming line, flows southeastward to a point about 2 miles west of Higho, Colo., and thence eastward into the North Platte at a point about 4 miles below the mouth of Roaring Fork. The stream flows through a narrow valley separated from the open prairie land of North Park by a high bluff, which slopes up gradually from the east side and then descends rather abruptly on the west to the river bottoms. The basin is mountainous in character, and much of it is covered with a heavy forest, consisting of several varieties of white pine and spruce and much quaking aspen and underbrush. The tributaries head among the snow banks in the highest portions of the Park Range, and after descending through narrow, precipitous canyons, enter the more or less rolling country at the foot of the range. The soil along the river bottoms consists of a black sandy loam and is well adapted to the raising of hay.

The gaging station was established May 14, 1904. It is located at the footbridge at Higho post-office, 7 miles northwest of Hebron and 12 miles west of Walden, Colo., in T. 9 N., R. 81 W.

The channel is straight for about 150 feet above and 50 feet below the station, and the current is medium. The right bank is about 3 feet high above and for a short distance below the gage, beyond which point it rises to a height of about 10 feet; the left bank is lower than the right and consists of a low bar, covered with willows and sloping gradually out from the stream. There is but one channel at low-water stages, but at high stages a second channel begins about 100 yards above the bridge, flows through the low sand bar at a distance of 50 yards from the left end of the bridge, and enters the main stream 150 yards below. The stream does not overflow the banks of either channel, except at very high stages, when the low land between the two channels may be submerged. The bed of the stream is composed of gravel and small cobblestones, and is free from vegetation and permanent. The current is swift at high stages and medium during ordinary stages. High-water measurements are somewhat affected by eddying currents and backwater caused by the pier at the left end of the bridge. Gage heights have a range of 1.5 feet. Readings are discontinued during the winter months on account of ice forming around the gage rod.

Discharge measurements are made at high water from the single-span footbridge to which the gage is attached. The initial point for soundings is a nail driven into the walk-log at the left end of the bridge. Low-water measurements are made by wading near the bridge.

The gage was read twice each day during 1905 by Mrs. Esther Bergquist, who lives near the station. It consists of a vertical staff spiked to the southwest face of the left abutment on the downstream side. The gage is referred to bench marks as follows: (1) A nail

driven into the top of the east end of the bottom log of the north abutment; elevation above the zero of the gage, 1.76 feet. (2) A point on the foundation stone under the northeast corner of the house of Charles Bergquist, marked "B.M.U.S.G.S."; elevation above the zero of the gage, 12.42 feet. The elevation above sea level is approximately 8,025 feet.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 23-25.

Discharge measurements of North Fork of North Platte River at Higho, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 18	W. A. Lamb	28	38	1.45	1.50	55
June 18	do	29	57	3.26	2.05	186
June 24	do	29	59	3.19	2.05	188
July 15	do	34	56	2.12	1.85	119
August 8	do	34	44	1.57	1.70	69
August 23	do	30	35	1.37	1.50	48
September 25	do	26	20	.65	1.09	13

NOTE. Measurements made at different sections.

Daily gage height, in feet, of North Fork of North Platte River at Higho, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.42	1.95	1.7	1.95	1.8	1.45	1.15
2	1.48	1.95	1.75	1.95	1.8	1.45	1.15
3	1.45	1.8	1.8	1.9	1.75	1.4	1.2
4	1.38	1.55	2.01	1.8	1.7	1.4	1.2
5	1.32	1.62	2.05	1.75	1.74	1.4	1.2
6	1.38	1.65	1.91	1.72	1.71	1.48	1.2
7	1.6	1.62	1.92	1.78	1.7	1.5	1.25
8	1.7	1.62	2.3	2.0	1.68	1.42	1.3
9	1.82	1.7	2.18	1.92	1.68	1.4	1.3
10	1.78	1.52	2.15	1.75	1.72	1.4	1.28
11	1.65	1.32	2.05	1.7	1.7	1.4	1.25
12	1.52	1.25	2.0	1.78	1.78	1.4	1.25
13	1.6	1.22	1.98	1.72	1.7	1.4	1.3
14	1.65	1.2	2.02	1.75	1.6	1.32	1.3
15	1.65	1.22	2.02	1.78	1.6	1.28	1.3
16	1.6	1.22	2.1	1.72	1.62	1.2	1.35
17	1.6	1.3	2.05	1.72	1.6	1.18	1.3
18	1.65	1.5	2.25	1.7	1.55	1.1	1.3
19	1.78	1.52	2.25	1.64	1.5	1.1	1.22
20	1.72	1.55	1.98	1.75	1.5	1.1	1.2
21	1.52	1.52	1.92	2.0	1.48	1.1	1.25
22	1.65	1.6	1.95	2.0	1.47	1.1	1.22
23	1.75	1.65	2.05	1.85	1.47	1.38	1.2
24	1.7	1.72	2.05	1.85	1.47	1.38	1.2
25	1.62	1.65	2.02	1.82	1.5	1.1	1.15
26	1.68	1.67	2.02	1.8	1.47	1.1	1.18
27	1.95	1.68	1.98	1.88	1.47	1.1	1.2
28	2.0	1.58	1.95	1.88	1.45	1.1	1.25
29	1.9	1.52	1.95	1.8	1.45	1.1	1.3
30	1.9	1.52	1.92	1.85	1.45	1.2	1.3
31	.....	1.62	.....	1.8	1.45	.....	1.22

Station rating table for North Fork of North Platte River at Higho, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
1.10	15	1.50	50	1.80	100	2.10	195
1.20	22	1.60	64	1.90	126	2.20	235
1.30	30	1.70	80	2.00	158	2.30	280
1.40	39						

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904-5, and is well defined between gage heights 1.4 feet and 2.2 feet.

Estimated monthly discharge of North Fork of North Platte River at Higho, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	158	32	76.3	4,540
May	142	22	61.9	3,806
June	280	80	162	9,640
July	158	70	107	6,579
August	100	44	65.8	4,046
September	50	15	29.6	1,761
October	34	18	25.3	1,556
The period				31,930

NORTH PLATTE RIVER NEAR HEBRON, COLO.

This station was established May 13, 1904. It is located at a highway bridge below the junction of Grizzly and Little Grizzly creeks, about 4 miles northwest of Hebron, Colo., in T. 9 N., R. 80 W.

The bridge lies in a curve of about 150 feet radius. The banks are about 5 feet high, lined with willows, and not liable to overflow. The bed of the stream is composed of gravel, sand, and small cobblestones, and is uniform, permanent, and free from vegetation. There is but one channel at all stages. The current is very sluggish at low water, but medium at high stages. Gage heights have a range of about 4 feet. Discharge measurements are affected by dead water, by backwater caused by the wooden piers of the bridge, and by driftwood which collects at the upper side of the bridge. Gage readings are impracticable during the winter months on account of the formation of ice around the gage rod.

Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached. The initial point for soundings is the inner face of the left abutment, marked zero.

The gage is read each day by J. E. Mallon, who lives one-half mile distant. It consists of a vertical staff fastened to the northeast corner of the first pier from the left bank. The gage is referred to bench marks as follows: (1) A nail driven flush with the top of the cap timber on the west side of the crib pier to which the gage is fastened, just across the pier from the gage; elevation, 9.44 feet above the zero of the gage. (2) A cross cut on a ledge of rock in the cliff on the left bank of the river about 50 feet north of the west end of the bridge, marked "B.M.;" elevation, 17.80 feet above the zero of the gage. The elevation above sea level is about 8,025 feet.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 20–23.

Discharge measurements of North Platte River near Hebron, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 18	W. A. Lamb	83	284	1.38	5.30	392
June 17	do	84	390	2.53	6.60	986
June 25	do	88	365	1.94	5.95	708
July 14	do	66	68	2.29	4.45	156
August 8	do	58	32	1.91	3.90	61
August 24	do	32	27	.89	3.50	24
September 25	do	28	21	1.05	3.31	22

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of North Platte River near Hebron, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		5.7	6.0	5.25	4.3	3.45	3.35
2		5.8	6.4	5.25	4.2	3.45	3.35
3		5.5	6.6	5.15	4.2	3.45	3.35
4		5.2	7.0	4.9	4.15	3.45	3.4
5		5.0	7.45	4.75	4.1	3.4	3.4
6		5.0	7.15	4.65	4.05	3.45	3.4
7		4.9	6.8	4.6	4.0	3.45	3.4
8		5.0	6.9	4.65	3.9	3.5	3.4
9	4.6	5.2	7.4	4.5	3.9	3.35	3.4
10	4.6	5.4	7.55	4.4	3.9	3.35	3.4
11	5.0	5.1	7.0	4.4	3.9	3.35	3.4
12	4.5	4.95	6.9	4.35	3.9	3.35	3.45
13	4.5	4.9	6.7	4.55	3.9	3.3	3.45
14	4.6	4.9	6.8	4.4	3.85	3.3	3.45
15	4.6	4.85	6.8	4.45	3.8	3.3	3.45
16	4.55	5.0	6.8	4.5	3.7	3.3	3.45
17	4.5	5.2	6.7	4.4	3.7	3.3	3.45
18	4.6	5.3	6.6	4.35	3.6	3.3	3.45
19	4.65	5.6	6.4	4.3	3.6	3.35	3.45
20	4.6	5.7	6.2	4.35	3.6	3.35	3.5
21	4.55	5.75	6.1	4.45	3.6	3.35	3.5
22	4.55	6.0	6.0	4.25	3.55	3.35	3.55
23	4.65	6.1	6.1	4.15	3.55	3.35	3.6
24	4.9	6.3	6.2	4.15	3.5	3.35	3.6
25	4.5	6.55	6.0	4.15	3.45	3.35	3.65
26	4.75	6.05	5.9	4.15	3.45	3.35	3.7
27	5.1	5.95	5.75	4.15	3.45	3.35	3.7
28	5.0	5.7	5.6	4.3	3.45	3.35	3.7
29	5.2	5.6	5.45	4.2	3.45	3.35	3.7
30	5.4	5.6	5.3	4.2	3.45	3.35	3.7
31		5.8		4.3	3.45		3.7

Station rating table for North Platte River near Hebron, Colo., from April 9 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*
3.30	15	4.20	110	5.10	315	6.00	705
3.40	20	4.30	125	5.20	355	6.20	800
3.50	25	4.40	140	5.30	395	6.40	900
3.60	35	4.50	160	5.40	435	6.60	1,000
3.70	45	4.60	180	5.50	480	6.80	1,100
3.80	55	4.70	200	5.60	525	7.00	1,200
3.90	65	4.80	225	5.70	570	7.20	1,310
4.00	80	4.90	250	5.80	615	7.40	1,420
4.10	95	5.00	280	5.90	660	7.60	1,530

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905, and is well defined between gage heights 3.3 feet and 6.5 feet.

Estimated monthly discharge of North Platte River near Hebron, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 9-30	435	160	215	9,382
May	975	238	479	29,450
June	1,502	395	950	56,530
July	375	102	164	10,080
August	125	22	54.3	3,339
September	25	15	18.5	1,101
October	45	18	27.4	1,685
The period				111,600

NORTH PLATTE RIVER NEAR COWDREY, COLO.

This station was established May 10, 1904. It is located at the wagon bridge about 2 miles northwest of Cowdrey, Colo., in T. 10 N., R. 80 W.

The channel is straight for 600 feet above and 900 feet below the station. Both banks are high and clean and are not subject to overflow. The bed of the stream is composed of coarse gravel and small cobblestones and is stable and uniform. There is but one channel at either high or low water. The current has a medium velocity at high and ordinary stages, but is sluggish at low stages. At the station the fall of the river is 4.2 feet per mile. During the winter months ice forms at the gage rod and gage readings are impracticable.

Discharge measurements are made by means of a car, cable, and tagged wire, one-fourth mile below the highway bridge. Soundings are marked on the tagged wire at 5-foot intervals, the initial point being the zero of the tagged wire near the left bank. At extreme low stages measurements are made by wading at convenient points near the bridge.

The gage, which was read twice each day during 1905 by C. M. Hendrickson, consists of a vertical staff spiked to the northeast corner of the first crib pier from the west end of the highway bridge above the cable. The foot marks are numbered from 2 to 12 feet, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows: (1) The top of a 30-penny nail driven flush with the top of the cap timber on the north end of the right abutment of the bridge; elevation, 13.22 feet above gage datum. (2) An iron wagon skein set in the right bank 10 feet north of the bridge, the top of the hub being 2 inches above the surface of the ground, the base resting on a stone 1 foot below the surface;

a witness stake is beside the bench-mark post; elevation of bench mark, 10.89 feet above gage datum. The elevation above sea level is about 7,860 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 25–28.

Discharge measurements of North Platte River near Cowdrey, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 19	W. A. Lamb	110	292	1.80	8.17	523
May 23	do	110	327	2.34	8.44	766
June 19	do	109	385	2.87	8.91	1,106
June 23	do	109	383	2.77	8.80	1,064
July 17	do	103	226	1.26	7.84	285
August 7	do	95	176	.84	7.59	148
Augus t22[a]	do	56	49	1.57	7.40	77
September 22[a]	do	26	29	.76	7.15	22

[a] Made at different section.

Daily gage height, in feet, of North Platte River near Cowdrey, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	8.6	8.1	8.4	8.42	7.75	7.45	7.35
2	8.65	8.2	8.7	8.25	7.75	7.42	7.35
3	8.6	8.15	8.85	8.2	7.7	7.4	7.35
4	8.6	7.95	9.05	8.18	7.72	7.45	7.35
5	8.5	7.8	9.3	8.12	7.72	7.5	7.35
6	7.85	7.7	9.5	7.98	7.72	7.75	7.38
7	7.85	7.7	9.25	7.88	7.7	7.82	7.45
8	7.8	7.7	9.0	7.82	7.7	7.75	7.45
9	7.95	7.8	9.6	7.75	7.72	7.65	7.45
10	8.05	7.95	9.6	7.82	7.7	7.65	7.45
11	7.65	8.05	9.45	7.75	7.7	7.5	7.42
12	7.6	7.95	9.2	7.75	7.7	7.45	7.38
13	7.65	7.85	9.05	7.75	7.65	7.45	7.32
14	7.55	7.85	9.1	7.75	7.6	7.05	7.3
15	7.75	7.85	9.05	7.78	7.6	7.08	7.3
16	7.6	7.85	9.05	7.75	7.6	7.12	7.3
17	7.7	7.95	9.15	8.02	7.55	7.2	7.3
18	7.6	8.1	8.85	7.8	7.55	7.2	7.3
19	7.7	8.15	8.9	7.8	7.55	7.2	7.3
20	7.7	8.2	8.75	7.8	7.5	7.2	7.3
21	7.6	8.3	8.65	7.85	7.52	7.2	7.3
22	7.55	8.35	8.7	7.9	7.48	7.18	7.3
23	7.65	8.45	8.7	7.92	7.45	7.15	7.3
24	7.7	8.55	8.7	7.75	7.45	7.15	7.3
25	7.6	8.65	8.7	7.7	7.55	7.15	7.3
26	7.7	8.55	8.7	7.7	7.5	7.18	7.3
27	7.8	8.55	8.65	7.75	7.5	7.2	7.3
28	7.95	8.45	8.68	7.72	7.5	7.22	7.3
29	8.0	8.45	8.52	7.72	7.48	7.35	7.3
30	8.05	8.5	8.52	7.72	7.4	7.35	7.35
31	.....	8.3	.....	7.72	7.4	.....	7.35

Station rating table for North Platte River near Cowdrey, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
7.10	12	7.80	270	8.50	793	9.20	1,523
7.20	27	7.90	334	8.60	880	9.30	1,650
7.30	47	8.00	398	8.70	974	9.40	1,781
7.40	75	8.10	466	8.80	1,070	9.50	1,916
7.50	108	8.20	540	8.90	1,172	9.60	2,056
7.60	154	8.30	622	9.00	1,282		
7.70	208	8.40	707	9.10	1,400		

The above table is applicable only for open-channel conditions. It is based on nineteen discharge measurements made during 1904-5 and is well defined between gage heights 7.5 feet and 9 feet. It has been extended beyond these limits, being based on one measurement at 7.2 feet. Above 7.5 feet the table is the same as for 1904.

Estimated monthly discharge of North Platte River near Cowdrey, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	926	130	345	20,530
May	926	208	505	31,050
June	2,056	707	1,246	74,150
July	724	208	316	19,430
August	238	75	156	9,592
September	283	5	76.7	4,564
October	91	47	58.3	3,585
The period				162,900

CANADIAN RIVER AT COWDREY, COLO.

Canadian River rises in North Park, Colorado, among the highest peaks of the Medicine Bow Range, flows northwestward, and enters the North Platte about 1 mile below the mouth of Michigan Creek. The upper part of the drainage basin is exceedingly mountainous and the small tributaries find their way through canyons to the valley below. In its lower course the stream traverses a narrow valley which it has worn in the lake beds of the park and which extends some distance into the foothill region. This valley differs from the other river valleys of the park in the more uniform slope and regular shape of its sides, in the character of the mesa lands on the right, and in the sandy nature of its soil. The mesa on the right contains numerous sand dunes and in some places near the foothills extensive deposits of sand and coarse, disintegrated granite. The soil of the river bottom is principally a sandy loam. Hay is the only crop raised. The storage or diversion of the water of this stream is impracticable.

The gaging station was established May 10, 1904. It is located at the highway bridge one-half mile east of Cowdrey, Colo., in sec. 7, T. 10 N., R. 79 W.

The channel is straight for 150 feet above and 40 feet below the station. Each bank is about 2 feet high and is clean and well sodded; the left overflows during extreme high water. The bed of the stream is composed of sand and silt, with a few stones from the riprap at the west end of the bridge, and is shifting. As the changes occur at irregular intervals it is a difficult matter to obtain a good rating curve. There is but one channel at all stages, broken by four pile bents of the bridge, and the current has a medium velocity. The ordinary range of gage heights is about 1.6 feet. Gage readings are impracticable during the winter months on account of the formation of ice around the gage rod.

At all normal stages discharge measurements are made by wading a short distance above the pile bridge to which the gage is attached. At exceedingly high stages measurements are made from the bridge, the downstream guard rail of which is marked at 2-foot intervals. The initial point for soundings is a 20-penny nail driven into the floor of the bridge over the face of the left abutment on the downstream side.

The gage, which was read twice each day during 1905 by C. M. Hendrickson, consists of a vertical staff graduated from 2 to 8 feet, attached to the west face of the first pile from the left bank on the downstream side of the bridge. The 2-foot mark rests on the bed of the stream. The gage is referred to bench marks as follows: (1) A 30-penny nail driven flush with the top of the cap timber above the gage rod; elevation, 9.80 feet. (2) A 30-penny nail driven horizontally into the north face of a telephone pole 60 feet south of the left end of the bridge, 3 feet above the ground; elevation, 9.80 feet. (3) A regulation iron bench-mark post 3 feet south of the fence on the north side of the road, 40 feet west of the gage rod; elevation, 8.02 feet. Elevations of bench marks are above the datum of the gage. The elevation above sea level is about 7,860 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 64–66.

Discharge measurements of Canadian River at Cowdrey, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 20	W. A. Lamb	34	56	1.41	4.85	79
June 20	do	35	56	2.23	5.10	125
June 23	do	53	65	1.95	5.05	127
July 17	do	28	26	1.58	4.47	41
August 7	do	31	25	1.36	4.43	34
August 22	do	15	13	1.23	4.10	16
September 22	do	14	9	1.11	4.05	10

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Canadian River at Cowdrey, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	5.5	4.8	4.9	4.68	4.55	4.05	4.2	4.35
2	5.6	4.9	5.05	4.65	4.45	4.05	4.2	.....
3	5.6	4.8	5.25	5.35	4.45	4.05	4.2	.....
4	5.75	4.7	5.6	5.15	4.45	4.02	4.2	.....
5	5.9	4.6	5.85	4.85	4.45	4.0	4.2	.....
6	5.8	4.5	5.9	4.7	4.45	4.1	4.2	.....
7	5.8	4.5	5.75	4.55	4.35	4.25	4.25	.....
8	5.75	4.4	5.8	4.4	4.3	4.18	4.25	.....
9	5.9	4.5	5.85	4.45	4.3	4.15	4.25	.....
10	5.9	4.55	6.15	4.48	4.3	4.15	4.25	.....
11	6.0	4.6	5.95	4.45	4.35	4.15	4.25	.....
12	5.7	4.6	5.6	4.45	4.4	4.15	4.25	.....
13	5.5	4.5	5.55	4.45	4.4	4.12	4.28	.....
14	5.25	4.4	5.65	4.5	4.4	4.1	4.35	.....
15	5.35	4.4	5.6	4.5	4.35	4.1	4.35	.....
16	5.05	4.4	5.6	4.5	4.35	4.1	4.35	.....
17	4.9	4.4	5.6	4.48	4.25	4.1	4.35	.....
18	4.65	4.7	5.3	4.48	4.1	4.1	4.32	.....
19	4.8	4.8	5.25	4.48	4.1	4.1	4.3	.....
20	4.7	4.9	5.1	4.45	4.1	4.05	4.3	.....
21	4.7	4.9	4.95	4.42	4.15	4.05	4.3	.....
22	4.75	4.9	4.95	4.42	4.1	4.08	4.3	.....
23	5.65	4.9	4.95	4.4	4.08	4.1	4.3	.....
24	4.65	4.9	4.98	4.25	4.02	4.1	4.3	.....
25	4.4	5.0	5.0	4.15	3.95	4.1	4.3	.....
26	4.6	5.0	4.92	4.2	3.85	4.05	4.3	.....
27	4.7	4.95	4.88	4.25	3.88	4.05	4.3	.....
28	4.9	4.9	4.85	4.25	3.95	4.05	4.3	.....
29	4.85	5.05	4.8	4.25	3.98	4.22	4.35	.....
30	4.75	5.1	4.7	4.4	4.05	4.22	4.35	.....
31	.....	4.95	.....	4.42	4.02	.....	4.35	.....

Station rating table for Canadian River at Cowdrey, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	1	4.50	40	5.10	130	5.70	350
3.90	3	4.60	50	5.20	155	5.80	400
4.00	6	4.70	60	5.30	185	5.90	450
4.10	10	4.80	75	5.40	220	6.00	510
4.20	15	4.90	90	5.50	260	6.10	570
4.30	22	5.00	110	5.60	300	6.20	630
4.40	30						

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904-5, and is well defined between gage heights 4 feet and 5.5 feet. It has been extended beyond these limits, being only approximate above 5.5 feet.

Estimated monthly discharge of Canadian River at Cowdrey, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	510	30	218	12,970
May	130	30	69.4	4,267
June	600	60	235	13,980
July	202	12	44.4	2,730
August	45	2	19.3	1,187
September	18	6	10.3	613
October	26	15	20.8	1,279
The period				37,030

MICHIGAN CREEK NEAR WALDEN, COLO.

Michigan Creek, the largest tributary of the North Platte in North Park from the east side, rises in the Rabbit Ears and Medicine Bow ranges, flows northwestward, and enters the main stream at a point 3 miles northwest of Cowdrey, Colo. The basin is rugged and mountainous, comprising the highest portion of the Medicine Bow Range in Colorado. The small tributaries of the creek extend far back into the range and interlace with tributaries of Grand and Cache la Poudre rivers. These small streams unite and emerge from the high mountainous areas into the more or less broken and rolling slopes and foothills which border the level prairie land of the park itself. The lower portion of the stream flows through a narrow valley, varying in width from one-fourth mile to 1 mile, bordered on either side by long bench-like ridges and rolling prairie land. The soil along the stream bottom is a black sandy loam and is very fertile, but on account of the great altitude practically the only crop grown is hay. The headwaters of the stream are well protected by heavy forests of white pine and spruce timber and a dense growth of quaking aspen and underbrush.

Illinois Creek, which joins Michigan Creek 2 miles below Walden, is the principal tributary stream. Its headwaters drain a low portion of the Rabbit Ears Range and its flow during the early part of the summer is large.

Water is being diverted from the headwaters of Michigan Creek to the Cache la Poudre on the eastern slope of the Rocky Mountains at a point known as Cameron Pass.

Two gaging stations were maintained on Michigan Creek during 1905, the first near Walden, the second at Cowdrey.

The Walden station was established May 9, 1904. It is located at the highway bridge 1½ miles north of Walden, Colo., in sec. 21, T. 9 N., R. 79 W., and is about 1 mile above the mouth of Illinois Creek.

The channel is straight for about 75 feet above and 50 feet below the station. The banks are about 3 feet high, are bordered with flat meadow lands, and do not overflow at this point. The bed of the stream is composed of sand and gravel and is free from vegetation and fairly permanent. There is but one channel at all stages, broken by the middle pier of the bridge. The current is swift at high stages and medium at low stages. High-water measurements are affected by backwater and eddies caused by the abutments and center pier of the bridge. Gage heights have a range of about 2 feet during an ordinary season. Gage readings in winter are impracticable owing to ice conditions.

High-water measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is a 30-penny nail driven into the floor at the west end of the bridge. At ordinary stages discharge measurements are made by wading a short distance above the bridge.

The gage, which was read twice each day during 1905 by H. E. Holdredge, consists of a staff graduated from 4 to 10 feet, fastened to the southwest corner of the center pier of the bridge, the 4-foot mark resting on the bed of the stream. The gage is referred to bench

marks as follows: (1) The top of a nail driven into the left abutment of the bridge on the downstream side; elevation, 7.91 feet above gage datum. (2) The top of a 20-penny nail driven into the top of a sandstone bowlder under the cliff on the north side of the river, about 275 feet northeast of the north end of the bridge, marked "B. M. U. S. G. S.;" elevation above gage datum, 15.34 feet. Elevation above sea level is about 7,975 feet.

This station was discontinued October 31, 1905.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 131, of the United States Geological Survey, pages 59–61.

Discharge measurements of Michigan Creek near Walden, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 19	W. A. Lamb	48	42	2.95	4.95	124
June 19	do	48	113	3.47	5.65	392
June 24	do	49	106	2.97	5.50	315
July 16	do	40	36	2.69	4.91	97
August 8	do	36	21	2.05	4.56	43
August 22	do	24	15	1.47	4.40	22
September 23	do	16	14	.71	4.32	10

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Michigan Creek near Walden, Colo., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	5.22	5.25	4.7	4.25	4.32	17	.....	5.72	4.8	4.52	4.25	4.35
2	.....	5.32	5.35	4.7	4.3	4.32	18	.....	5.68	4.78	4.48	4.25	4.35
3	.....	5.42	5.28	4.68	4.22	4.32	19	4.98	5.6	4.78	4.48	4.25	4.32
4	.....	5.48	5.25	4.62	4.22	4.3	20	5.05	5.45	4.75	4.42	4.22	4.32
5	.....	5.7	5.12	4.62	4.28	4.3	21	5.05	5.4	4.72	4.4	4.22	4.35
6	.....	5.9	5.0	4.58	4.32	4.32	22	5.1	5.42	4.7	4.4	4.2	4.38
7	.....	5.8	4.92	4.58	4.4	4.32	23	5.18	5.38	4.68	4.38	4.2	4.38
8	.....	5.82	4.9	4.48	4.38	4.32	24	5.2	5.5	4.7	4.32	4.2	4.4
9	.....	5.92	4.88	4.5	4.38	4.32	25	5.15	5.48	4.7	4.32	4.28	4.4
10	.....	6.05	4.88	4.58	4.32	4.32	26	5.08	5.42	4.68	4.35	4.28	4.4
11	.....	6.08	4.85	4.6	4.3	4.32	27	5.12	5.45	4.68	4.3	4.28	4.42
12	.....	5.85	4.8	4.65	4.25	4.32	28	5.02	5.4	4.7	4.3	4.28	4.42
13	.....	5.8	4.82	4.68	4.25	4.32	29	5.12	5.38	4.7	4.28	4.28	4.42
14	.....	5.95	4.85	4.58	4.22	4.32	30	5.1	5.3	4.7	4.28	4.3	4.42
15	.....	5.88	4.8	4.48	4.22	4.32	31	5.1	.....	4.7	4.25	.....	4.42
16	.....	5.78	4.8	4.52	4.2	4.38							

Station rating table for Michigan Creek near Walden, Colo., from May 19, to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.20	5	4.70	60	5.20	190	5.70	410
4.30	10	4.80	80	5.30	225	5.80	465
4.40	20	4.90	100	5.40	265	5.90	520
4.50	30	5.00	125	5.50	310	6.00	580
4.60	45	5.10	155	5.60	360	6.10	640

The above table is applicable only for open-channel conditions. It is based on fourteen discharge measurements made during 1904–5, and is well defined between gage heights 4.3 feet and 5.8 feet.

Estimated monthly discharge of Michigan Creek near Walden, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May (19-31)	190	120	155	3,997
June	628	197	377	22,430
July	245	57	97.5	5,995
August	60	8	31.2	1,918
September	20	5	8.9	530
October	22	10	15.1	928
The period				35,800

MICHIGAN CREEK[a] NEAR COWDREY, COLO.

This station was established May 9, 1904. It is located 100 feet above the wagon bridge 1½ miles west of Cowdrey, Colo., in sec. 11, T. 10 N., R. 80 W., and is below all tributaries.

The channel is straight for 50 feet above and 100 feet below the station. The right bank is a gradually sloping gravel bar which extends back about 80 feet; the left bank is about 5.5 feet high and is well sodded. At high stages the stream overflows the right bank for a distance of 75 feet from the main channel. The bed is composed of gravel and is free from vegetation, uniform, and permanent. There is but one channel at all stages. In some places the current is swift and uniform; in others backwater, eddies, and dead water occur. Near the bridge the channel is in poor condition, being obstructed by piles and ruined piers of the bridge. The ordinary range of gage heights is about 3 feet. The channel at the gage is almost entirely frozen over during the winter months, making gage readings impossible.

Discharge measurements are made at high stages from the downstream side of the wagon bridge. Low-water measurements are made by wading at convenient points above the bridge.

The gage, which was read twice each day during 1905 by C. M. Hendrickson, consists of an inclined staff spiked firmly to posts set into the left bank about 75 feet above the bridge. This gage was washed out during the high water of June, 1905, but was replaced in its original position and datum. The gage is referred to bench marks as follows: (1) A 30-penny nail driven into the top of the south end of the cap timber of the first pile bent at the east end of the bridge; a witness nail is driven in beside it; elevation of bench mark above the zero of the gage, 6.23 feet. (2) A standard iron-post bench mark, located 3 feet south of the fence on the south side of the road, 75 feet north of the gage rod and 50 feet west of the river bank; elevation above the zero of the gage, 6.26 feet. The elevation above sea level is about 7,870 feet.

This station was discontinued October 31, 1905.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 61–64.

[a] For description of creek see p. 190.

Discharge measurements of Michigan Creek near Cowdrey, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 19	W. A. Lamb	40	47	2.84	2.60	134
June 20	do	80	130	3.09	3.65	402
June 23	do	77	118	2.87	3.40	339
July 17	do	40	40	2.05	2.40	82
August 7	do	37	30	1.70	2.23	51
August 22	do	28	17	1.24	1.90	21
September 22	do	20	6.6	.98	1.67	6.5

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Michigan Creek near Cowdrey, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2.5	3.0	3.4	3.2	2.45	1.7	1.8	2.0
2	2.55	3.15	3.6	3.1	2.4	1.7	1.8	.....
3	2.5	3.2	3.7	3.1	2.42	1.7	1.8	.....
4	3.15	2.85	4.0	2.98	2,42	1.75	1.8	.....
5	3.35	2.8	4.4	2.9	2.4	1.85	1.8	.....
6	3.2	2.6	4.6	2.85	2.42	1.9	1.8	.....
7	3.0	2.4	4.6	2.7	2.4	1.95	1.8	.....
8	2.65	2.4	4.6	2.68	2.32	1.88	1.8	.....
9	2.7	2.5	4.7	2.55	2.28	1.85	1.8	.....
10	2.7	2.6	4.5	2.52	2.35	1.85	1.8	.....
11	2.55	2.6	4.4	2.55	2.32	1.78	1.8	.....
12	2.55	2.5	4.3	2.5	2.3	1.75	1.8	.....
13	2.55	2.3	4.2	2.5	2.3	1.75	1.8	.....
14	2.55	2.3	4.1	2.5	2.3	1.75	1.85	.....
15	2.45	2.25	4.0	2.5	2.3	1.75	1.92	.....
16	2.4	2.2	3.9	2.48	2.25	1.75	1.95	.....
17	2.45	2.3	3.8	2.42	2.2	1.75	1.95	.....
18	2.4	2.5	3.7	2.38	2.08	1.75	1.95	.....
19	2.45	2.5	3.6	2.38	2.0	1.75	1.9	.....
20	2.45	2.55	3.5	2.38	2.0	1.72	1.9	.....
21	2.45	2.85	3.4	2.4	2.0	1.7	1.9	.....
22	2.4	2.95	3.4	2.38	1.9	1.7	1.9	.....
23	2.4	3.1	3.4	2.42	1.9	1.7	1.9	.....
24	2.4	3.3	3.38	2.42	1.88	1.7	1.9	.....
25	2.4	3.5	3.35	2.35	1.82	1.75	1.9	.....
26	2.4	3.4	3.3	2.35	1.82	1.72	1.9	.....
27	2.6	3.4	3.25	2.38	1.85	1.7	1.9	.....
28	2.75	3.3	3.28	2.4	1.82	1.72	1.9	.....
29	2.8	3.35	3.18	2.4	1.75	1.8	1.92	.....
30	2.85	3.5	3.15	2.5	1.65	1.8	1.95	.....
31	.....	3.35	.....	2.45	1.65	.....	1.98	.....

NOTE.—Gage heights estimated June 10-20, inclusive.

Station rating table for Michigan Creek near Cowdrey, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	4	2.40	85	3.20	270	4.00	515
1.70	7	2.50	105	3.30	300	4.10	550
1.80	12	2,60	125	3.40	330	4.20	585
1.90	20	2.70	145	3.50	360	4.30	620
2.00	30	2.80	170	3.60	390	4.40	655
2.10	40	2.90	195	3.70	420	4.50	690
2.20	55	3.00	220	3.80	450	4.60	725
2.30	70	3.10	245	3.90	480	4,70	760

The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904-5. It is well defined between gage heights 1.7 feet and 2.6 feet and fairly well defined to 3.6 feet. It has been extended beyond these limits.

Estimated monthly discharge of Michigan Creek near Cowdrey, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	315	85	133	7,914
May	360	55	186	11,440
June	760	258	466	27,730
July	270	78	122	7,501
August	95	6	50.7	3,117
September	25	7	10.9	649
October	28	12	17.5	1,076
The period				59,430

NORTH PLATTE RIVER AT SARATOGA, WYO.

This station was established June 9, 1903. It is located at a point about 100 yards below the two-span iron-truss bridge which connects East and West Saratoga, in T. 17 N., R. 84 W.

The middle pier of the bridge divides the stream into two channels with almost equal capacity in high or low water periods. The banks are high and do not overflow. The bed of the stream is composed of rock and gravel and is subject to little change. The current is swift at ordinary stages, but at extreme low water a sort of basin is formed by the backing up of the water by the riffles below, and the undercurrent is very sluggish. There are no obstructions in the river above or below the station to interfere with the natural flow, but at certain seasons each year a "tie drive" blocks the stream for a few days. The range of gage readings is about 6 feet.

Discharge measurements are made from the bridge. The initial point for soundings during high water is at the pier on the east end of the bridge and at ordinary stages is at the center pier.

The gage was read twice daily during 1905 by J. M. Sterrett, who lives about one-fourth of a mile distant. It consists of a flexible Gurley rod fastened securely to a timber spiked to the cribwork at the northeast corner of what was formerly the Saratoga Club property. The bench mark is a spike driven into a cottonwood tree 7 inches in diameter standing 30 feet northwest of the gage; elevation, 9.84 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description. 99, p 174. 131, pp 30-31.
Discharge: 84, p 94; 99, p 175; 131, p 31.
Discharge, monthly: 99, p 176; 131, p 33.
Gage heights: 99, p 175; 131, p 32.
Rating table: 99, p 176; 131, p 33.

Discharge measurements of North Platte River at Saratoga, Wyo., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 24	A. J. Parshall	203	487	0.85	1.91	416
April 17	do	221	610	1.37	2.40	835
April 28	J. M. Sterrett	226	721	2.15	2.90	1,550
April 29	do	232	776	2.43	3.10	1,885
May 2	do	234	850	3.06	3.50	2,604
May 19	do	243	936	3.53	3.80	3,308
May 20	do	244	1,010	4.30	4.10	4,344
May 22	do	248	1,138	4.93	4.60	5,603
May 24	do	250	1,212	5.54	4.95	6,717
June 3	do	251	1,304	5.72	5.25	7.455
June 4	do	251	1,385	6.22	5.55	8,610
June 5	do	251	1,524	7.32	6.10	11,153
June 6	do	251	1,442	6.78	5.80	9,790
September 9[a]	A. J. Parshall	105	126	2.35	1.70	296

[a] Made by wading one-fourth mile below station.

Daily gage height, in feet, of North Platte River at Saratoga, Wyo., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.72	2.02	3.25	4.72	3.68	2.35	1.55	1.68	1.54	1.79
2	1.72	2.05	3.45	4.92	3.58	2.32	1.52	1.68	1.68	1.87
3	1.72	2.02	3.45	5.18	3.78	2.28	1.52	1.66	1.82	1.85
4	1.78	2.02	3.28	5.6	3.6	2.22	1.52	1.66	1.94	1.87
5	1.78	2.0	3.08	6.0	3.38	2.2	1.55	1.66	1.95	1.82
6	1.85	2.1	2.95	5.68	3.22	2.15	1.62	1.62	1.89	1.7
7	2.02	2.18	2.88	5.65	3.08	2.08	1.7	1.6	1.88	1.62
8	1.8	2.32	2.9	5.65	3.0	1.95	1.78	1.57	1.83	1.78
9	1.75	2.6	3.12	6.1	3.0	1.9	1.72	1.6	1.8	1.69
10	1.75	2.72	3.2	6.05	2.95	1.9	1.66	1.58	1.7	.....
11	1.78	2.68	3.15	5.7	2.85	1.95	1.62	1.58	1.68	.....
12	1.8	2.45	3.05	5.58	2.7	2.18	1.56	1.62	1.66	.....
13	1.85	2.55	2.95	5.48	2.65	2.18	1.56	1.62	1.66	.....
14	1.85	2.68	2.9	5.3	2.6	2.08	1.51	1.7	1.68	.....
15	1.9	2.55	2.85	5.2	2.68	1.98	1.48	1.69	1.78	.....
16	1.92	2.48	2.9	5.18	2.6	1.92	1.44	1.68	1.8	.....
17	1.95	2.4	3.12	5.22	2.58	1.88	1.4	1.72	1.83	.....
18	1.98	2.38	3.5	4.95	2.52	1.82	1.42	1.72	1.86	.....
19	2.0	2.4	3.8	4.7	2.42	1.72	1.44	1.69	1.79	.....
20	1.98	2.55	4.05	4.55	2.6	1.7	1.46	1.68	1.64	.....
21	2.02	2.5	4.22	4.5	2.62	1.68	1.42	1.62	1.64	.....
22	2.05	2.42	4.52	4.5	2.6	1.62	1.41	1.72	1.6	.....
23	2.0	2.45	4.7	4.48	2.52	1.6	1.42	1.74	1.63	.....
24	2.02	2.5	4.82	4.5	2.38	1.6	1.4	1.78	1.7	.....
25	1.98	2.5	4.7	4.4	2.25	1.58	1.42	1.8	1.74	.....
26	2.02	2.48	4.7	4.32	2.2	1.55	1.44	1.82	1.7	.....
27	2.08	2.62	4.68	4.22	2.18	1.55	1.48	1.82	1.82	.....
28	2.02	2.88	4.7	4.1	2.18	1.55	1.47	1.81	1.78	.....
29	1.9	3.05	4.48	3.9	2.2	1.52	1.51	1.82	1.72	.....
30	2.02	3.05	4.38	3.8	2.2	1.5	1.50	1.82	1.53	.....
31	2.05	.....	4.48	.....	2.25	1.5	.....	1.68	.....	.....

NOTE.—Gage heights estimated March 1-4.

Station rating table for North Platte River at Saratoga, Wyo., from March 1 to December 9, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	180	2.50	970	3.60	2,905	4.70	5,945
1.50	215	2.60	1,095	3.70	3,145	4.80	6,265
1.60	255	2.70	1,230	3.80	3,390	4.90	6,590
1.70	300	2.80	1,375	3.90	3,645	5.00	6,920
1.80	355	2.90	1,530	4.00	3,905	5.20	7,590
1.90	415	3.00	1,695	4.10	4,175	5.40	8,270
2.00	485	3.10	1,870	4.20	4,455	5.60	8,960
2.10	565	3.20	2,055	4.30	4,740	5.80	9,660
2.20	655	3.30	2,250	4.40	5,030	6.00	10,360
2.30	750	3.40	2,455	4.50	5,325		
2.40	855	3.50	2,675	4.60	5,630		

The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1905, and is well defined between gage heights 1.7 feet and 6 feet.

Estimated monthly discharge of North Platte River at Saratoga, Wyo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	549	311	425	26,130
April	1,778	485	952	56,650
May	6,330	1,452	3,329	204,700
June	10,710	3,390	7,019	417,700
July	3,341	637	1,404	86,330
August	802	215	430	26,440
September	344	180	226	13,450
October	367	243	299	18,380
November	450	227	334	19,870
December 1-9	397	264	344	6,141
The period				875,800

NORTH PLATTE RIVER AT GUERNSEY, WYO.

This station was established June 14, 1900. It was originally located at the highway bridge about half a mile northwest of Guernsey, Wyo., in sec. 35, T. 27 N., R. 66 W., but at the opening of the season of 1902 the gage rod was removed to the railroad bridge 300 feet above the first location.

The channel is straight both above and below the station. The banks are high and not liable to overflow. The bed of the stream is sandy but fairly permanent. The channel is broken by two piers and six rows of piling, but no other obstructions above or below interfere with the flow. The ordinary range of gage heights is about 7 feet. At the highway bridge the bed of the channel is more changeable, but the velocity is more uniform.

Discharge measurements are still made from the highway bridge. The initial point for soundings is on the left bank.

The gage was observed during 1905 by W. F. Peterson, who lives about 100 yards distant. The 1902 gage was fastened to one of the piers of the railroad bridge and was placed 1 foot lower than the original gage had been. In the latter part of 1903 the 1902 gage was replaced by a new one with its zero at the same elevation as that of the old gage. The new rod was attached to the pile of the railroad bridge, which had been recently reconstructed.

The 1902 bench mark was a spike driven into the sleeper of the highway bridge at an elevation of 10.04 feet above gage datum. The 1903 bench mark is a United States Geological Survey monument 125 feet east of the gage rod; elevation above the zero of the gage, 13.72 feet. The elevation of the zero of the gage above sea level is 4,317 feet. The reconstruction of the bridge under which the gage was placed interfered somewhat with convenient reading, and in 1905 a secondary gage rod was placed nearer the bank for use during lower stages of water.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 49, p 275; 66, p 27; 84, pp 68-69; 99, pp 165-166; 131, pp 35-36.
Discharge: WS 49, p 275; 66, p 27; 84, p 69; 99, p 166; 131, p 36.
Discharge, monthly: Ann 22, iv, p 312; WS 75; p 125; 84, p 70; 99, p 167; 131, p 38.
Gage heights: WS 49, p 275; 66, p 27; 84, p 69; 99, p 166; 131, p 37.
Hydrograph: WS 75, p 126.
Rating tables: WS 52, p 516; 66, p 171; 84, p 70; 99, p 167; 131, p 38.

Discharge measurements of North Platte River at Guernsey, Wyo., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 22	A. J. Parshall	208	428	2.54	1.00	1,089
April 14	do	296	625	3.28	1.65	2,052
May 3	do	329	1,214	4.95	3.50	6,007
May 4	do	330	1,306	5.24	3.80	6,838
May 13	do	330	1,156	4.41	3.20	5,094
May 29	do	330	1,855	5.80	5.25	10,760
June 2	do	330	1,751	5.52	5.00	9,660
June 3	do	330	1,697	5.33	4.80	9,053
June 8	do	330	2,073	6.11	6.00	12,670
June 9	do	330	2,078	6.14	6.00	12,760
July 20	do	297	585	2.71	1.45	1,586
July 21	do	297	580	2.67	1.42	1,549
July 27	do	312	713	3.37	1.95	2,405
July 28	do	311	620	3.15	1.65	1,949
August 3	do	287	613	3.05	1.58	1,870
August 21	do	201	360	2.19	.85	788
August 22	do	200	354	2.12	.80	749
August 30	do	195	300	1.45	.38	434
September 5	do	189	263	1.29	.20	340
September 23	do	186	250	1.20	.10	300
October 7	do	196	307	1.55	.45	478

Daily gage height, in feet, of North Platte River at Guernsey, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.0	2.85	5.25	3.85	1.85	0.55	0.1	0.5
2	1.0	3.05	5.0	5.3	1.85	.25	.3	.5
3	1.0	3.5	4.88	3.75	1.45	.25	.38	.5
4	1.0	3.8	4.95	3.45	1.3	.25	.3	.5
5	1.0	3.7	5.05	3.25	1.1	.2	.32	.5
6	1.1	3.7	5.25	3.1	1.0	.2	.38	.5
7	1.12	3.75	5.6	3.25	1.0	.2	.45	.52
8	1.2	3.8	5.95	3.15	1.25	.25	.5	.55
9	1.2	3.9	6.0	2.85	1.0	.3	.45	.6
10	1.28	3.8	6.0	2.55	1.0	.4	.4	.6
11	1.38	3.6	6.0	2.35	1.0	.45	.35	.65
12	1.4	3.3	6.4	2.15	1.3	.5	.3	.65
13	1.45	3.2	6.3	2.05	1.8	.4	.3	.62
14	1.65	3.2	6.15	2.0	1.15	.48	.3	.6
15	1.9	3.1	6.05	2.0	1.0	.4	.3	.6
16	2.0	3.05	5.95	1.88	.9	.4	.35	.55
17	1.8	3.0	5.75	1.75	.8	.4	.32	.52
18	1.8	2.9	5.65	1.65	.8	.4	.35	.5
19	1.85	2.9	5.55	1.55	.95	.35	.35	.5
20	1.95	3.1	5.45	1.48	.9	.3	.35	.5
21	2.15	3.2	5.25	1.72	.85	.25	.35	.5
22	2.1	3.4	4.95	1.7	.8	.2	.4	.5
23	2.15	5.15	4.75	1.5	.7	.2	.4	.55
24	2.4	4.3	4.45	1.4	.62	.15	.4	.58
25	3.15	4.35	4.35	1.4	.55	.12	.4	.6
26	3.3	4.7	4.25	1.5	.5	.1	.45	.6
27	3.05	5.0	4.15	1.6	.48	.1	.45	.7
28	3.25	5.1	4.1	1.7	.5	.1	.5	.68
29	3.4	5.2	4.0	1.5	.48	.1	.5	.55
30	3.0	5.35	3.9	2.0	1.2	.1	.5	.50
31	.....	5.4	.....	1.65	1.0	.....	.5	.....

Station rating table for North Platte River at Guernsey, Wyo., from April 1 to June 12, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1,090	2.10	2,795	3.20	5,125	4.60	8,770
1.10	1,225	2.20	2,970	3.30	5,370	4.80	9,310
1.20	1,365	2.30	3,150	3.40	5,620	5.00	9,860
1.30	1,510	2.40	3,340	3.50	5,870	5.20	10,410
1.40	1,660	2.50	3,540	3.60	6,125	5.40	10,970
1.50	1,815	2.60	3,750	3.70	6,385	5.60	11,540
1.60	1,970	2.70	3,965	3.80	6,645	5.80	12,120
1.70	2,130	2.80	4,185	3.90	6,905	6.00	12,700
1.80	2,290	2.90	4,410	4.00	7,170	6.20	13,300
1.90	2,455	3.00	4,640	4.20	7,700	6.40	13,900
2.00	2,625	3.10	4,880	4.40	8,230		

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during the first part of 1905, and is fairly well defined. Owing to shifting conditions this table is not applicable subsequent to high water.

Station rating table for North Platte River at Guernsey, Wyo., from June 13, to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-ft.*
0.10	295	0.80	765	1.50	1,670	2.20	2,925
.20	335	.90	865	1.60	1,835	2.30	3,125
.30	385	1.00	975	1.70	2,005	2.40	3,330
.40	445	1.10	1,095	1.80	2,180	2.50	3,540
.50	515	1.20	1,225	1.90	2,360		
.60	590	1.30	1,365	2.00	2,545		
.70	675	1.40	1,515	2.10	2,730		

The above table is applicable only for open-channel conditions. It is based on eleven discharge measurements made during the latter part of 1905, and is fairly well defined. Above 2.5 feet the table is the same as the preceding one.

Estimated monthly discharge of North Platte River at Guernsey, Wyo., for 1905.

[Drainage area, 16,240 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	5,620	1,090	2,544	151,400	0.157	0.175
May	10,970	4,298	6,745	414,700	.415	.478
June	13,900	6,905	10,580	629,600	.651	.726
July	10,690	1,515	3,289	202,200	.203	.234
August	2,270	501	1,041	64,010	.064	.074
September	552	295	382	22,730	.024	.027
October	515	295	435	26,750	.027	.031
November	675	515	559	33,260	.034	.038
The period				1,545,000		

NORTH PLATTE RIVER AT ALCOVA, WYO.

This station was established February 19, 1904, by John E. Field. It is located at the highway bridge 1,000 feet southwest of the post-office at Alcova, Wyo. There are no running tributaries entering the river in this vicinity.

The channel is straight for 1,500 feet above and 800 feet below the station. The current is swift in the center and sluggish near the banks. Both banks are high, clean, and not liable to overflow. The bed of the stream is rocky, covered with small bowlders, and is permanent. The river is divided by the bridge piers into ten channels at low water and thirteen channels at high water. The bottom at the measuring section is rough and uneven, and this may affect the accuracy somewhat.

Measurements are made from the downstream side of the bridge. The initial point for soundings is the north end of the downstream hand rail.

The gage is a staff fastened to the northeast corner of the crib pier supporting the center of the bridge. During 1905 the gage was read twice a day by A. F. Hollebaugh. The bench mark is a standard United States Geological Survey iron post located at the west quarter corner of sec. 19, T. 30 N., R. 82 W. It is about 1,000 feet due north of the post-office. Its elevation is 5,366 feet above sea level and 36.67 feet above the gage datum.

July 20, 1905, a measurement was made by L. V. Branch with the following result: Area of section, 670 square feet; mean velocity, 1.68 feet per second; gage height, 5.42 feet; discharge, 1,126 second-feet.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 34–35.

Daily gage height, in feet, of North Platte River at Alcova, Wyo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.85	4.32	5.0	6.85	9.5	7.6	5.0	3.9	4.0	4.18	3.9
2	3.7	3.8	4.35	5.05	6.85	9.7	7.4	5.1	3.9	3.95	4.3	4.0
3	3.85	3.8	4.38	5.05	7.15	9.9	7.25	5.2	3.8	4.3	4.22	4.1
4	3.85	3.8	4.48	5.08	7.35	10.1	7.3	5.1	3.8	4.25	4.15	4.05
5	3.85	3.8	4.7	5.12	7.35	10.8	7.3	5.05	3.9	4.1	4.15	4.05
6	3.85	3.75	4.75	5.05	7.05	11.35	7.15	4.95	4.25	4.1	4.32	3.95
7	3.85	3.75	4.82	4.95	6.85	11.3	6.85	4.9	4.4	4.1	4.4	4.0
8	3.85	3.8	4.8	5.02	6.65	11.05	6.6	4.9	4.25	4.1	4.58	3.9
9	3.75	3.8	4.78	5.05	6.52	11.0	6.45	4.8	4.4	4.05	4.52	3.95
10	3.7	3.7	4.8	5.2	6.6	11.3	6.28	4.7	4.3	4.0	4.52	3.9
11	3.85	3.65	4.75	5.65	7.0	11.5	6.2	4.65	4.3	4.0	4.48	3.8
12	3.75	3.8	4.85	6.1	7.15	11.1	6.05	4.65	4.2	4.0	4.4	3.8
13	3.65	3.8	4.9	5.9	7.0	10.6	5.95	4.55	4.1	4.0	4.4	3.8
14	3.5	3.8	4.92	5.75	6.78	10.55	5.8	4.7	4.1	4.0	4.28	3.8
15	3.6	3.8	4.95	5.65	6.7	10.2	5.7	5.0	4.0	4.0	4.22	3.7
16	3.75	3.8	5.1	5.8	6.55	10.15	5.6	4.95	3.9	4.0	4.2	3.6
17	3.85	3.8	5.35	5.85	6.55	10.05	5.6	4.75	3.9	4.12	4.32	3.7
18	3.9	3.85	5.32	5.8	6.65	10.0	5.5	4.6	3.9	4.18	4.4	3.7
19	3.85	3.95	5.2	5.7	7.1	9.8	5.4	4.45	3.9	4.18	4.42	3.7
20	3.85	4.0	5.15	5.68	7.75	9.35	5.45	4.4	3.8	4.2	4.45	3.8
21	3.9	4.05	5.15	5.7	8.45	9.0	5.5	4.3	3.78	4.3	4.5	3.8
22	3.95	4.0	5.15	5.85	8.8	8.8	5.45	4.25	3.75	4.25	4.42	3.85
23	3.9	4.05	5.15	5.85	9.15	8.7	5.4	4.2	3.75	4.2	4.38	3.65
24	3.9	4.1	5.15	5.82	9.55	8.7	5.4	4.2	3.8	4.12	4.22	3.55
25	3.95	4.1	5.15	5.9	9.75	8.7	5.25	4.1	3.78	4.15	3.65	3.55
26	4.0	4.15	5.1	6.15	9.9	8.5	5.15	4.0	3.75	4.2	3.82	3.5
27	4.0	4.15	5.1	6.15	9.85	8.4	5.05	4.0	3.7	4.35	3.9	3.4
28	4.05	4.25	5.15	6.08	9.8	8.15	4.95	4.0	3.7	4.22	4.05	3.5
29	4.05	.....	5.12	6.28	9.95	8.05	4.9	3.9	3.7	4.32	4.25	3.4
30	4.05	.....	5.05	6.75	9.75	7.75	5.2	3.9	3.9	4.42	3.8	3.25
31	3.85	.....	5.05	.....	9.5	.....	5.1	3.9	.....	4.35	.....	3.45

NOTE.—Probable ice condition January, February, March, and December.

Station rating table for North Platte River at Alcova, Wyo., from February 21, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	110	4.90	760	6.40	2,200	8.80	6,325
3.50	130	5.00	830	6.50	2,330	9.00	6,770
3.60	155	5.10	900	6.60	2,465	9.20	7,225
3.70	180	5.20	975	6.70	2,600	9.40	7,685
3.80	210	5.30	1,055	6.80	2,740	9.60	8,155
3.90	245	5.40	1,140	6.90	2,885	9.80	8,635
4.00	285	5.50	1,230	7.00	3,030	10.00	9,120
4.10	325	5.60	1,320	7.20	3,330	10.20	9,630
4.20	370	5.70	1,415	7.40	3,645	10.40	10,160
4.30	415	5.80	1,515	7.60	3,980	10.60	10,720
4.40	465	5.90	1,620	7.80	4,335	10.80	11,300
4.50	520	6.00	1,730	8.00	4,700	11.00	11,900
4.60	575	6.10	1,840	8.20	5,080	11.20	12,150
4.70	635	6.20	1,955	8.40	5,475	11.40	13,130
4.80	695	6.30	2,075	8.60	5,890		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904–5, and is fairly well defined between gage heights 4.5 feet and 9.5 feet. Below 4.5 feet the table is uncertain.

Estimated monthly discharge of North Platte River at Alcova, Wyo., for 1904–5.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
April	2,958	747	1,729	102,900
May	11,450	3,210	5,900	362,800
June	8,395	3,485	6,758	402,100
July	3,517	695	1,808	111,200
August	816	440	582	35,790
September	1,302	210	389	23,150
October	647	361	482	29,640
November 1–19	465	110	307	11,570
The period				1,079,000
1905.				
April	2,670	795	1,394	82,950
May	8,998	2,357	4,707	289,400
June	13,440	4,245	8,855	526,900
July	3,980	760	1,817	111,700
August	975	245	574	35,290
September	465	180	273	16,240
October	476	265	347	21,340
November	564	168	406	24,160
The period				1,108,000

NOTE.—No estimate for ice period.

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station was established June 3, 1902. It is located at a highway bridge 1 mile south of Mitchell, Nebr., in sec. 27, T. 23 N., R. 56 W., and replaces the station at Gering, Nebr.

The channel is straight for 2,000 feet above and below the station. Both banks are low and sandy, but are not liable to overflow. The bed of the stream is composed entirely of shifting sand to a depth of 20 feet or more. At high stages there are three channels and at low stages there are from three to forty channels. The current is never sluggish, even at extreme low water. The river is frozen during the winter months. The range of gage heights is about 5.5 feet.

Discharge measurements are made from the upstream side of the highway bridge, which has a total span of 1,565 feet and is supported on pile bents 20 feet apart. The initial point for soundings is the zero mark at the north end of the bridge.

A standard chain gage, which was read during 1905 by B. H. Newbold, is fastened to the upstream end of the hand rail near the center of the bridge. The length of the chain is 10.60 feet. The gage is referred to bench marks as follows: (1) A cross cut in the floor of the bridge at the gage; elevation, 9.74 feet. (2) The head of a nail in the top of the west end of the cap of the first bent at the north end of the bridge; elevation, 8.56 feet. (3) A standard aluminum bench-mark cap, marked "U. S. G. S. B. M.," leaded into the top of a 2-inch gas pipe 4 feet long, located 138 feet north and 30 feet east of the north end of the downstream hand rail; elevation, 8.64 feet. Elevations are above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 66, p 28; 84, p 66; 99, pp 162-163; 131, p 39.
Discharge: 66, p 28; 84, p 67; 99, p 163; 131, p 40.
Discharge, monthly: 75, p 126; 84, p 68; 99, p 165; 131, p 41.
Gage heights: 66, p 28; 84, p 67; 99, p 164; 131, p 40.
Rating tables: 84, p 68; 99, p 164; 131, p 41.

Discharge measurements of North Platte River near Mitchell, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29	H. C. Gardner	1,575	648	1.83	2.40	1,186
May 12	do	1,225	2,385	3.61	4.15	8,619
June 13	do	1,037	3,954	4.24	5.20	16,770
July 11	do	1,050	1,513	2.54	3.25	3,852
July 20	do	800	760	2.13	2.50	1,622
August 3	do	762	871	2.31	2.75	2,014
September 21	F. S. Dobson	450	215	1.77	1.92	383
September 7	H. C. Gardner	450	266	2.39	1.95	507

Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.87	1.67	2.72	2.5	4.1	5.0	4.1	2.7	2.1	1.9
2	1.79	.....	2.65	2.6	4.1	4.9	4.1	2.6	2.0	1.9
3	1.77	.....	2.4	2.6	4.2	4.8	4.1	2.7	2.0	1.9
4	1.8	.....	2.37	2.55	4.3	4.8	3.9	2.7	2.0	1.9
5	1.81	.....	2.35	2.5	4.4	4.8	3.8	2.6	2.0	1.9
6	1.76	.....	2.34	2.5	4.3	4.8	3.7	2.6	1.9	1.9
7	1.77	.....	2.32	2.5	4.4	4.8	3.6	2.6	1.9	1.9
8	1.78	.....	2.3	2.5	4.5	4.9	3.6	2.5	2.0	1.9
9	1.75	.....	2.34	2.5	4.4	5.1	3.5	2.5	2.0	1.9
10	1.74	.....	2.35	2.5	4.4	5.0	3.4	2.5	1.95	1.9
11	1.65	.....	2.34	2.6	4.3	5.0	3.2	2.5	1.9	1.9
12	1.64	.....	2.25	2.7	4.2	5.0	3.2	2.5	1.9	1.9
13	1.64	.....	2.3	2.7	4.2	5.2	3.1	2.65	1.9	1.9
14	1.65	.....	2.27	2.8	4.15	5.2	3.0	2.8	1.9	2.0
15	1.66	.....	2.35	2.8	4.1	5.0	2.9	2.6	1.9	2.0
16	1.76	.....	2.38	2.9	4.1	4.9	2.85	2.5	1.9	2.0
17	1.71	.....	2.41	3.0	4.1	4.8	2.8	2.4	1.9	1.9
18	1.82	.....	2.35	3.1	4.0	4.8	2.7	2.3	1.9	1.9
19	1.86	.....	2.4	3.1	3.9	4.8	2.6	2.3	1.9	1.9
20	1.88	.....	2.35	3.1	3.9	4.7	2.6	2.25	1.9	2.0
21	1.95	.....	2.4	3.1	4.0	4.7	2.5	2.2	1.9	2.0
22	2.0	2.1	2.45	3.3	4.1	4.6	2.5	2.3	1.9	2.0
23	2.05	2.15	2.5	3.4	4.2	4.4	2.55	2.3	1.9	2.0
24	2.1	2.25	2.45	3.5	4.9	4.3	2.6	2.2	1.9	2.0
25	1.87	2.3	2.35	3.6	4.7	4.25	2.6	2.2	1.9	2.0
26	2.07	2.53	2.42	4.1	4.6	4.2	2.5	2.2	1.9	2.0
27	2.09	2.55	2.4	4.2	4.6	4.1	2.7	2.15	1.9	2.0
28	2.01	2.6	2.36	4.1	4.7	4.0	2.8	2.1	1.9	2.0
29	1.8	.....	2.42	4.3	4.8	4.0	2.8	2.0	1.9	2.05
30	1.72	.....	2.45	4.2	4.9	4.0	2.75	2.0	1.9	2.1
31	1.69	.....	2.42	.....	4.9	.....	2.7	2.0	.....	2.1

NOTE.—Ice conditions during January and February.

Station rating table for North Platte River near Mitchell, Nebr., from January 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	380	2.80	2,260	3.70	6,050	4.60	11,900
2.00	520	2.90	2,570	3.80	6,600	4.70	12,700
2.10	670	3.00	2,900	3.90	7,150	4.80	13,500
2.20	840	3.10	3,260	4.00	7,700	4.90	14,300
2.30	1,030	3.20	3,650	4.10	8,300	5.00	15,100
2.40	1,250	3.30	4,070	4.20	8,900	5.10	15,900
2.50	1,480	3.40	4,520	4.30	9,600	5.20	16,800
2.60	1,720	3.50	5,000	4.40	10,300		
2.70	1,980	3.60	5,500	4.50	11,100		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905 and is fairly well defined.

Estimated monthly discharge of North Platte River near Mitchell, Nebr., for 1905.

[Drainage area, 24,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches
March	2,036	935	1,239	76,180	0.051	0.059
April	9,600	1,480	3,573	212,600	.146	.163
May	14,300	7,150	10,010	615,500	.410	.473
June	16,800	7,700	12,760	759,300	.523	.584
July	8,300	1,480	3,594	221,000	.147	.170
August	2,260	520	1,296	79,690	.053	.061
September	670	380	420	24,990	.017	.019
October	670	380	460	28,280	.019	.022
The period				2,018,000		

NOTE.—No estimate for ice period.

NORTH PLATTE RIVER AT BRIDGEPORT, NEBR.

This station was established May 4, 1902. It is located at the highway bridge on the public road about one-half mile north of Bridgeport, Nebr., in sec. 28, T. 20 N., R. 50 W.

At the gaging section the channel is narrowed by a dike built as a bridge approach, but is straight for a considerable distance both above and below. The banks are low, but are not liable to overflow. The bed is composed of shifting sand. There is but one channel at ordinary or high stages, but at low water the stream is divided into many winding channels. The water is never sluggish.

Discharge measurements are made from the upstream side of the highway bridge, which is supported by pile bents about 20 feet apart. The initial point for soundings is the zero mark on the hand rail at the south end of the bridge.

The gage, which was read during 1905 by Porter Hannawald, is of the wire and weight type and is fastened to theupstream hand rail of the bridge. The length of the wire is 12.80 feet. The gage is referred to bench marks as follows: (1) A 6 by 6 inch stone, marked "U. S. C.& G. S.," in the NE. ¼, sec. 32, T. 20 N., R. 50 W., of the sixth principal meridian, 130 feet east of the east gate of the stock yards and 300 feet northwest of the northwest corner of the public school building; elevation, 9.94 feet. (2) A standard aluminum United States Geological Survey bench-mark cap set in a 20 by 12 by 6 inch stone located about 50 feet south and a little east of the northeast corner of lot No. 4, block No. 2, of the Riverside addition to Bridgeport, Nebr.; elevation, 11.32 feet. (3) The head of a nail in the top of the west end of the cap of the south bent of the bridge; elevation, 10.14 feet. Elevations are above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 64; 99, pp 159-160; 131, p 42.
Discharge: 84, p 65; 99, pp 160-161; 131, p 43.
Discharge, monthly: 84, p 66; 99, p 162; 131, p 44.
Gage heights: 84, p 65; 131, p 43.
Rating tables: 84, p 66; 99, p 162; 131, p 44.

Discharge measurements of North Platte River at Bridgeport, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29	H. C. Gardner	2,200	845	1.67	5.10	1,417
May 12	do	2,200	4,150	2.66	6.30	11,040
June 14	do	2,190	4,904	3.57	7.00	17,550
July 12	do	2,190	2,039	2.26	5.65	4,608
July 21	do	1,960	1,287	1.84	5.40	2,367
August 4	do	2,060	1,298	1.92	5.45	2,504
September 13	A. Dobson	639	232	1.57	4.91	366

Daily gage height, in feet, of North Platte River at Bridgeport, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		5.5	6.45	6.83	6.25	5.46	4.8	4.86
2		5.7	6.43	6.81	6.25	5.54	4.84	4.9
3		5.52	6.4	6.75	6.25	5.37	4.93	4.92
4		5.3	6.4	6.65	6.35	5.44	4.87	4.94
5		5.27	6.37	6.62	6.2	5.48	4.94	4.95
6		5.27	6.5	6.55	6.0	5.36	4.9	4.93
7		5.25	6.41	6.57	5.95	5.35	4.87	4.9
8		5.32	6.43	6.78	5.88	5.37	4.9	4.9
9		5.35	6.45	6.86	5.85	5.31	4.9	4.9
10		5.32	6.4	6.8	5.8	5.3	4.96	4.93
11		5.43	6.46	6.9	5.75	5.33	4.94	4.95
12		5.36	6.33	6.9	5.68	5.21	4.93	4.97
13		5.42	6.3	6.95	5.6	5.27	4.91	4.98
14		5.35	6.25	6.98	5.5	5.16	4.95	5.23
15		5.37	6.25	7.0	5.35	5.3	4.9	5.15
16		5.3	6.3	6.95	5.43	5.39	4.87	5.1
17		5.38	6.25	6.8	5.43	5.13	4.87	5.1
18		5.62	6.28	6.8	5.4	5.05	4.89	5.08
19		5.6	6.25	6.8	5.34	5.0	4.97	5.03
20		5.9	6.28	6.7	5.25	4.96	5.0	5.02
21		5.57	6.15	6.6	5.37	4.9	4.95	5.07
22		5.62	6.26	6.65	5.37	4.98	4.9	5.05
23		5.8	6.25	6.6	5.05	4.95	4.9	5.1
24		6.0	6.6	6.6	5.32	4.9	4.9	5.08
25		6.0	6.53	6.5	5.16	4.86	4.92	5.08
26		6.02	6.5	6.35	5.13	5.06	4.87	5.06
27		6.2	6.52	6.3	5.43	5.07	4.88	5.08
28		6.2	6.6	6.25	5.42	4.9	4.87	5.0
29	5.1	6.2	6.55	6.2	5.38	4.88	4.86	5.1
30	5.25	6.4	6.57	6.15	5.54	4.9	4.88	5.08
31	5.27		6.7		5.43	4.88		5.1

Station rating table for North Platte River at Bridgeport, Nebr., from March 29 to July 11, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.10	1,400	5.60	4,400	6.10	8,750	6.60	13,700
5.20	1,900	5.70	5,250	6.20	9,700	6.70	14,700
5.30	2,400	5.80	6,100	6.30	10,700	6.80	15,700
5.40	3,000	5.90	6,950	6.40	11,700	6.90	16,700
5.50	3,700	6.00	7,800	6.50	12,700	7.00	17,700

The above table is based on four discharge measurements made during 1905 and is fairly well defined between gage heights 5.1 feet and 7 feet.

From July 12 to 21 the rating table was applied indirectly. After July 21 the following table was used:

Station rating table for North Platte River at Bridgeport, Nebr., from July 22 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.80	200	5.10	930	5.30	1,720	5.50	2,920
4.90	350	5.20	1,270	5.40	2,300	5.60	3,600
5.00	600						

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905 and the general form of the 1904 curve. It is not well defined.

Estimated monthly discharge of North Platte River at Bridgeport, Nebr., for 1905.

[Drainage area, 23,190 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	11,700	2,150	4,822	286,900	0.208	0.232
May	14,700	9,225	11,710	720,000	.505	.582
June	17,700	9,225	14,430	858,600	.622	.664
July	11,200	765	4,536	278,900	.196	.226
August	3,192	290	1,316	80,920	.057	.066
September	600	200	370	22,020	.016	.018
October	1,405	290	685	42,120	.030	.035
The period				2,289,000		

NORTH PLATTE RIVER AT NORTH PLATTE, NEBR.

This station was established October 5, 1894. It is located 3½ miles above the junction of North and South Platte rivers, at a highway bridge about one-half mile north of the city of North Platte, in sec. 28, T. 14 N., R. 30 W. It is the lowest station on the river.

The channel is nearly straight for about 500 feet both above and below the station. The banks are low, but are rarely, if ever, overflowed. The bed is composed of shifting sand. The river flows in two channels separated by a large island. The north channel is narrow and except in moderately high water is dry. At low stages the water is confined to a few channels along the right bank. The only obstructions in the channel are the pile bents and inclined ice guards of the bridge. The current is never sluggish, even at low stages. One small tributary, Birdwood Creek, maintains a small flow of water at the gaging station during months when the river itself would otherwise be entirely dry. During the winter months the river often freezes almost solid, since it is very shallow.

Discharge measurements are made from the highway bridge, which consists of 93 spans supported on pile bents 20 feet apart. The initial point for soundings is on the right bank.

The gage, which was read during 1905 by H. E. Dress, is a vertical staff spiked to the piling of the Union Pacific Railroad bridge 2 miles below the wagon bridge. The bench mark is the top of the east rail directly over the top of the gage rod; elevation, 12.00 feet. It is customary to refer the elevation of the water surface at the gaging section during measurements to the top of the upstream end of the cap of the second bent from the right-bank end of the highway bridge.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull.=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 156-157; 19, iv, p 306; Bull 131, p 30; 140, pp 99-100; WS 15, p 86; 27, p 76; 37, pp 220-221; 49, p 277; 66, p 28; 84, p 62; 99, pp 157-158; 131, pp 44-45.

Discharge: Ann 13, iii, p 82; 18, iv, p 157; 20, iv, pp 301, 302; Bull 131, p 92; 140, p 100; WS 15, p 86; 27, p 86; 37, p 221; 49, p 277; 66, p 28; 84, p 62; 99, p 158; 131, p 45.

Discharge, monthly: Ann 18, iv, p 158; 19, iv, p 310; 20, iv, pp 263, 269; 21, iv, p 199; Bull 140, p 102; WS 84, p 64; 99, p 159; 131, p 47.

Discharge, yearly: Ann 20, iv, p 54.

Gage heights: Bull 140, p 102; WS 11, p 52; 15, p 86; 27, p 81; 37, p 221; 49, p 278; 66, p 29; 84, p 63; 99, pp 158, 161; 131, p 46.

Hydrographs: Ann 19, iv, p 310; 21, iv, p 199.

Rainfall and run-off relation: Ann 20, iv, p 266.

Rating tables: Ann 18, iv, pp 157-158; Bull 140, p 101; WS 27, p 88; 39, p 447; 84, p 63; 99, p 159; 131, p 46.

Discharge measurements of North Platte River at North Platte, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 31	G. W. Bates	1,460	1,020	2.11	2.40	2,157
May 16	do	1,960	3,002	3.08	3.35	9,677
June 12	H. C. Gardner	1,950	5,213	3.37	3.95	17,570
June 20	do	1,970	4,875	3.28	3.75	16,010
July 13	do	3,740	2,336	2.51	2.75	5,878
July 22	do	1,760	1,500	2.34	2.40	3,513
August 5	do	1,120	1,294	1.98	2.20	2,564
September 20	F. S. Dobson		426	1.65	1.80	703
October 24	Dobson and Bates	1,020	563	1.87	1.98	1,056
September 9	H. C. Gardner		462	1.59	1.70	735

Daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.58	3.18	3.65	3.4	2.52	1.6	1.48
2	.....	2.62	3.32	3.88	3.65	2.48	1.55	1.5
3	.....	2.65	3.45	3.88	3.68	2.45	1.5	1.55
4	.....	2.75	3.38	3.88	3.38	2.3	1.52	1.55
5	2.85	2.7	3.38	3.68	3.28	2.22	1.62	1.58
6	2.75	2.62	3.4	3.58	3.38	2.22	1.7	1.65
7	2.62	2.48	3.45	3.5	3.18	2.18	1.72	1.65
8	2.5	2.38	3.48	3.48	3.1	2.15	1.7	1.65
9	2.4	2.25	3.5	3.52	3.0	2.18	1.7	1.6
10	2.45	2.28	3.4	3.72	2.9	2.1	1.72	1.65
11	2.5	2.38	3.48	3.88	2.82	2.05	1.7	1.72
12	2.4	2.35	3.5	4.02	2.8	2.0	1.65	1.72
13	2.4	2.42	3.5	3.95	2.75	2.2	1.65	1.65
14	2.5	2.45	3.55	3.9	2.62	2.2	1.75	1.65
15	2.42	2.5	3.4	4.08	2.52	2.18	1.85	1.82
16	2.68	2.45	3.35	4.28	2.42	2.02	1.68	1.78
17	2.82	2.45	3.2	4.08	2.32	2.0	1.58	1.72
18	2.7	2.48	3.18	3.9	2.2	1.92	1.68	1.78
19	2.82	2.45	3.18	3.8	2.28	1.95	1.82	1.8
20	2.65	2.42	3.28	3.75	2.42	2.02	1.9	1.9
21	2.5	2.8	3.2	3.6	2.5	1.85	1.8	1.9
22	2.4	2.8	3.1	3.6	2.42	1.8	1.75	1.9
23	2.32	2.72	3.05	3.62	2.28	1.75	1.8	1.85
24	2.28	2.9	3.1	3.62	2.28	1.68	1.72	1.9
25	2.28	3.12	3.28	3.42	2.3	1.68	1.68	1.98
26	2.25	3.1	3.28	3.32	2.18	1.7	1.62	1.9
27	2.25	3.0	3.82	3.28	2.2	1.68	1.58	1.9
28	2.38	2.9	3.65	3.18	2.18	1.65	1.55	2.0
29	2.4	3.05	3.78	3.12	2.38	1.6	1.6	2.05
30	2.38	3.22	3.7	3.22	2.1	1.75	1.6	2.02
31	2.4	.....	3.65	.....	2.18	1.72	.....	2.0

Station rating table for North Platte River at North Platte, Nebr., from March 5 to June 15, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	1,630	2.80	4,620	3.30	9,080	3.80	15,440
2.40	2,150	2.90	5,370	3.40	10,200	3.90	16,900
2.50	2,700	3.00	6,190	3.50	11,400	4.00	18,400
2.60	3,290	3.10	7,080	3.60	12,680	4.10	19,930
2.70	3,930	3.20	8,040	3.70	14,030		

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905, and is poorly defined. Owing to the shifting character of the stream bed, all estimates based on this and the following table are merely rough approximations.

Station rating table for North Platte River at North Platte, Nebr., from June 16 to September 10, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	360	2.30	3,050	3.00	7,910	3.70	15,430
1.60	530	2.40	3,600	3.10	8,810	3.80	16,690
1.70	740	2.50	4,200	3.20	9,770	3.90	17,970
1.80	1,000	2.60	4,850	3.30	10,790	4.00	19,270
1.90	1,310	2.70	5,540	3.40	11,870	4.10	20,590
2.00	1,670	2.80	6,280	3.50	13,010	4.20	21,930
2.10	2,080	2.90	7,070	3.60	14,200	4.30	23,280
2.20	2,540						

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. From September 11 to October 31 the discharge was obtained by the indirect method.

Estimated monthly discharge of North Platte River at North Platte, Nebr., for 1905.

[Drainage area, 28,520 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 5-31	4,995	1,390	2,727	146,000	0.096	0.096
April	8,248	1,390	3,743	222,700	.131	.146
May	15,730	6,635	10,270	631,500	.360	.415
June	23,010	9,002	14,700	874,700	.515	.575
July	15,180	2,080	5,983	367,900	.210	.242
August	4,330	530	1,862	114,500	.065	.075
September	1,000	260	585	34,810	021	.023
October	1,270	200	616	37,880	.022	.025
The period				2,430,000		

LARAMIE RIVER AT GLENDEVEY, COLO.

Laramie River rises on the east side of the Medicine Bow Range in Colorado, flows northwestward into Wyoming, and thence north and northeast until it joins the North Platte at Fort Laramie, Wyo. The drainage basin, which is narrow and very mountainous in its upper portion, broadens considerably in the middle and lower portions. The middle portion comprises the Laramie plains and surrounding foothills. The plains are about 30 miles wide and 80 miles long, extend north and south, and are bounded by the Laramie Hills on the east and the foothills of the Medicine Bow Range on the west. After passing around the Laramie Hills the river flows out on the Great Plains until it joins the North Platte. The soil throughout the entire area is sandy and along the river bottoms is fertile. Above the Laramie Plains the altitude is too great to permit the raising of crops other than hay and a few of the hardier cereals. Numerous small ditches divert the water of the stream to the hay lands along the first bottom and to a considerable extent to the higher lands on either side. Cattle raising is the chief industry. In the lower portion of the valley irrigation is practiced to some extent, and large crops are produced each year. There are extensive forests of pine and spruce on the headwaters of the stream, which lie in the Medicine Bow Forest Reserve.

The largest tributary from the west is the Little Laramie, which rises near the center of the Medicine Bow Range, flows eastward out on the Laramie Plains, and enters the main river

10 miles north of the city of Laramie. Its drainage area is similar in every respect to that of the upper and middle portions of the Laramie. The principal tributary of the Laramie on the right bank is Chugwater Creek, which rises in the Laramie Hills and joins the river about 18 miles above its mouth. The valley of Chugwater Creek is broad and fertile and the entire stream is used for irrigation during the summer season.

McIntyre Creek, the largest tributary of the Laramie in Colorado, is described on page 215, in connection with the gaging station at Gleneyre, Colo.

The Glendevey gaging station was established June 24, 1904. It is located at the highway bridge at Glendevey, Colo., on the State road between Walden and Fort Collins, in T. 9 N., R. 76 W.

The channel is straight for about 100 feet above and 300 feet below the station. Both banks are high and covered with a dense growth of willows and the stream does not overflow even at very high stages. The bed is composed of bowlders and coarse gravel and is free from vegetation and permanent. There is but one channel at all stages, broken by three piers. Gage heights have an ordinary range of about 2.5 feet. During the winter months the channel is obstructed by ice and gage readings are impracticable. The current is swift at high stages and medium at low stages. Discharge measurements are affected by the bowlders on the bed of the stream and by the piers of the bridge.

Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached. The initial point for soundings is a 30-penny nail driven into the guard log directly above the east face of the wooden pier at the left end of the bridge.

The gage, which was read twice each day during 1905 by E. S. Graves, consists of a vertical staff, graduated from 1 foot to 8 feet, attached to the northwest corner of the first pier from the right bank. The 1-foot mark rests on the bed of the stream. The gage is referred to bench marks as follows: (1) A cross cut in the top of a granite bowlder 18 inches in diameter, 10 feet northwest of the initial point for soundings; elevation, 7.32 feet above the zero of the gage. (2) A cross cut in the top of a granite bowlder 3 feet in diameter, 75 feet northwest of the initial point for soundings; elevation, 16.84 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 66–67.

Discharge measurements of Laramie River at Glendevey, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 22	W. A. Lamb	52	76	4.00	2.72	304
June 22	do	50	92	4.61	3.05	424
July 20	do	45	52	2.42	2.30	126
August 5	do	35	41	1.80	2.10	74
August 20	do	34	33	1.36	1.99	45
September 20	do	25	26	.96	1.91	25

Daily gage height, in feet, of Laramie River at Glendevey, Colo., for 1905.

Day.	Apr.	May	June	July	Aug.	Sept.	Oct.
1	1.82	2.25	3.4	2.7	2.25	1.95	1.8
2	1.82	2.25	3.45	2.7	2.2	2.0	1.8
3	1.82	2.25	3.85	2.65	2.2	1.9	1.8
4	1.82	2.2	4.1	2.45	2.2	1.9	1.8
5	1.85	2.15	4.1	2.4	2.15	1.9	1.8
6	1.9	2.15	3.9	2.3	2.1	1.9	1.8
7	1.9	2.15	3.8	2.3	2.1	1.9	1.8
8	1.9	2.22	4.0	2.35	2.1	1.9	1.8
9	1.9	2.22	4.3	2.4	2.1	1.9	1.8
10	1.9	2.25	4.15	2.35	2.1	1.9	1.8
11	1.85	2.25	3.6	2.4	2.15	1.9	1.8
12	1.9	2.25	3.6	2.45	2.15	1.9	1.8
13	1.9	2.25	3.55	2.4	2.1	1.9	1.8
14	1.9	2.2	3.5	2.4	2.1	1.9	1.8
15	1.9	2.2	3.65	2.4	2.1	1.85	1.8
16	1.88	2.28	3.65	2.3	2.05	1.8	1.8
17	1.9	2.4	3.65	2.35	2.0	1.8	1.8
18	1.88	2.45	3.45	2.35	2.0	1.9	1.85
19	1.88	2.48	3.2	2.35	2.0	1.9	1.9
20	1.88	2.58	3.05	2.3	2.0	1.85	1.9
21	1.92	2.75	3.05	2.3	1.95	1.8	1.8
22	1.92	2.9	3.05	2.3	1.9	1.8	1.8
23	1.92	3.1	3.15	2.2	1.9	1.8	1.8
24	1.92	3.28	3.1	2.2	1.9	1.8	1.8
25	1.95	3.35	3.1	2.25	1.9	1.8	1.8
26	1.95	3.1	3.1	2.3	1.9	1.8	1.8
27	2.05	3.05	3.1	2.35	1.9	1.8	1.8
28	2.15	3.1	3.0	2.4	1.95	1.8	1.8
29	2.15	3.05	2.85	2.35	1.95	1.8	1.8
30	2.15	3.0	2.75	2.3	1.9	1.8	1.8
31	.....	3.25	.....	2.3	1.9	.....	1.8

Station rating table for Laramie River at Glendevey, Colo., from June 24, 1904, to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	7	2.50	205	3.20	495	3.90	830
1.90	25	2.60	245	3.30	540	4.00	880
2.00	50	2.70	285	3.40	585	4.10	930
2.10	75	2.80	325	3.50	630	4.20	985
2.20	105	2.90	365	3.60	680	4.30	1,040
2.30	135	3.00	405	3.70	730		
2.40	170	3.10	450	3.80	780		

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1904-5, and is well defined between gage heights 2 feet and 3 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Laramie River at Glendevey, Colo., for 1904–5.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
June 24-30	405	265	299	4,151
July	405	90	165	10,140
August	90	50	63.4	3,898
September	50	25	31.7	1,886
October	50	7	26.6	1,636
The period				21,710
1905.				
April	90	11	31.3	1,862
May	562	90	263	16,170
June	1,040	305	627	37,310
July	285	105	162	9,961
August	120	25	60.7	3,732
September	50	7	18.5	1,101
October	25	7	8.5	523
The period				70,660

LARAMIE RIVER NEAR JELM, WYO.

This station was established June 22, 1904. It is located at a wagon bridge at H. T. Decker's ranch, one-half mile south of the Colorado-Wyoming State line, near Jelm, Wyo., in sec. 22, T. 12 N., R. 77 W., below all tributaries in Colorado.

The channel is straight for about 50 feet above and 300 feet below the station. Both banks are high and covered with willows and are not liable to overflow. The bed of the stream is composed of gravel and bowlders and is firm. There is but one channel at all stages, broken by the three piers of the bridge. The water is swift at high stages and medium at low stages. Discharge measurements are affected by large bowlders in the channel and also by the piers of the bridge. Gage heights have an ordinary range of about 4 feet. During the winter months the channel is obstructed by ice and gage readings are impracticable.

Discharge measurements are made from the downstream side of the four-span bridge to which the gage is attached. The initial point for soundings is a 30-penny nail driven into the left end of the downstream guard rail.

The gage, which was read during 1905 by Mr. Decker, consists of a staff fastened in a vertical position to the northwest corner of the center pier of the bridge. The bench mark is a 30-penny nail driven into the lower log at the southwest corner of Mr. Decker's house; elevation, 12.35 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 67-68.

Discharge measurements of Laramie River near Jelm, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 21	W. A. Lamb	57	123	4.47	3.80	550
June 21	do	59	148	4.93	4.20	730
July 18	do	57	75	2.27	2.55	170
August 6	do	43	63	1.86	2.40	117
August 21	do	39	47	1.51	2.31	71
September 21 [a]	do	36	45	.93	1.98	42

[a] Made by wading.

Daily gage height, in feet, of Laramie River near Jelm, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.8	2.45	5.25	3.55	2.6	2.0	1.9
2	1.8	2.55	5.4	3.55	2.6	2.0	1.9
3	1.8	2.5	5.6	3.55	2.6	2.0	1.9
4	1.8	2.4	5.9	3.35	2.5	2.0	1.8
5	1.9	2.4	6.15	3.1	2.5	2.0	1.8
6	1.9	2.4	5.8	2.9	2.5	2.1	1.8
7	2.0	2.4	5.8	2.8	2.5	2.1	1.8
8	2.0	2.5	5.95	2.8	2.5	2.1	1.8
9	2.1	2.65	6.2	2.9	2.5	2.0	1.9
10	2.0	2.6	6.0	2.8	2.5	2.0	1.9
11	2.0	2.5	5.3	2.7	2.5	2.0	1.9
12	2.0	2.5	5.3	2.7	2.5	2.0	1.9
13	2.0	2.5	5.4	2.75	2.4	2.0	1.9
14	2.0	2.5	5.25	2.7	2.4	2.0	1.9
15	2.0	2.5	5.25	2.7	2.3	1.9	1.9
16	2.0	2.5	5.15	2.65	2.3	1.9	1.9
17	2.0	2.8	5.15	2.6	2.2	1.9	1.9
18	2.0	3.2	4.8	2.6	2.2	1.9	1.8
19	2.0	3.45	4.4	2.6	2.2	1.9	1.8
20	2.05	3.8	4.35	2.7	2.2	1.9	1.8
21	2.0	4.0	4.25	2.7	2.2	1.9	1.8
22	2.1	4.5	4.25	2.6	2.1	1.8	1.8
23	2.0	4.85	4.2	2.5	2.1	1.8	1.8
24	2.0	4.95	4.2	2.45	2.1	1.8	1.9
25	2.05	4.75	4.05	2.45	2.1	1.9	1.9
26	2.1	4.7	3.95	2.5	2.1	1.9	1.9
27	2.25	4.7	3.9	2.55	2.1	1.9	1.9
28	2.35	4.7	3.9	2.6	2.1	2.0	1.8
29	2.35	4.5	3.7	2.6	2.1	2.0	1.8
30	2.4	4.5	3.5	2.6	2.1	1.9	1.8
31	.....	4.85	.....	2.6	2.0	.....	1.8

Station rating table for Laramie River near Jelm, Wyo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*	*Feet.*	*Second-ft.*
1.80	22	2.80	210	3.80	555	4.80	1,045
1.90	33	2.90	240	3.90	600	4.90	1,100
2.00	45	3.00	270	4.00	645	5.00	1,155
2.10	58	3.10	300	4.10	690	5.20	1,270
2.20	73	3.20	330	4.20	735	5.40	1,390
2.30	91	3.30	365	4.30	785	5.60	1,515
2.40	112	3.40	400	4.40	835	5.80	1,645
2.50	135	3.50	435	4.50	885	6.00	1,780
2.60	185	3.60	475	4.60	935	6.20	1,920
2.70	160	3.70	515	4.70	990		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905 and two during 1904, and is not well defined.

Estimated monthly discharge of Laramie River near Jelm, Wyo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	112	22	50.1	2,981
May	1,128	112	458	28,160
June	1,920	435	1,160	69,020
July	455	124	212	13,040
August	160	45	97.8	6,014
September	58	22	39.6	2,356
October	33	22	27.7	1,703
The period				123,300

M'INTYRE CREEK AT GLENEYRE, COLO.

McIntyre Creek rises in the Medicine Bow Mountains, flows northeastward, and unites with Laramie River at Gleneyre, Colo., about 12 miles south of the Colorado-Wyoming State line. The entire basin is mountainous, and the greater portion of it is covered by heavy forests of pine and spruce and dense growths of quaking aspen and underbrush. No irrigation is carried on except near the mouth, where water is diverted to the bottom land along the stream. A project is being considered to divert water from the head of the stream by means of a canal, inverted siphon, and tunnel, to the headwaters of Cache la Poudre River.

The gaging station was established June 23, 1904. It is located at the wagon bridge on Joseph Smith's ranch at Gleneyre, Colo., in sec. 20, T. 11 N., R. 76 W.

The channel is straight for about 200 feet above and 30 feet below the station. The right bank is low, is partly covered by willows, and at high water overflows for a distance of 40 feet from the main channel. The left bank is high and covered with willows. The bed of the stream is covered with gravel and small bowlders, and is firm. There is but one channel at all stages. The velocity is swift at high water and medium at low water. The current at the upper side of the bridge is somewhat obstructed by bowlders in the bed of the stream. Gage heights have an ordinary range of 3 feet. During the winter months ice forms in the channel to such an extent as to make gage readings impracticable.

At all normal stages discharge measurements are made by wading at convenient points below the bridge. High-water measurements are made from the upstream side of the two-

span bridge to which the gage is attached. The initial point for soundings is a nail driven into the guard rail of the upstream side of the bridge directly above the gage rod.

The gage was read twice daily during 1905 by Elbert E. Smith, who lives about three-fourths of a mile south of the station. It consisted originally of a staff attached vertically to a post driven into the bed of the stream and fastened at the top to the end of the bridge. This gage was washed out June 11, 1905, and was replaced by a sloping gage, which was located 2 feet above the original one. The rod is set sloping in the bank and fastened to three posts set firmly in the ground. It reads from 0.5 foot to 5 feet. The datum of the new gage is the same as that of the old one. The bench mark is the top of an iron rod, three-fourths of an inch in diameter and 2½ feet long, with an L-shaped bend at the lower end, resting on a granite bowlder, 14 inches in diameter, which is set 2 feet under ground, 30 feet northeast of the gage; elevation, 5.31 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 69–70.

Discharge measurements of McIntyre Creek at Gleneyre., Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 22	W. A. Lamb	32	52	3.71	3.20	193
June 22	do	33	59	2.59	2.85	153
July 19	do	24	20	1.65	1.90	33
August 6	do	21	14	1.50	1.75	21
August 20	do	12	15	.80	1.63	12
September 21	do	10	13	.60	1.55	7.8

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of McIntyre Creek at Gleneyre, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.52	1.75	4.15	2.75	1.82	1.58	17	1.58	1.88	3.75	1.82	1.62	.....
2	1.52	1.8	4.15	2.55	1.82	1.58	18	1.58	1.88	3.55	1.82	1.62	.....
3	1.52	1.8	4.35	2.5	1.78	1.58	19	1.58	1.88	3.35	1.8	1.62	.....
4	1.55	1.8	4.35	2.48	1.78	.....	20	1.58	1.85	3.25	2.0	1.62	.....
5	1.55	1.8	4.3	2.25	1.78	.....	21	1.58	3.1	3.2	1.92	1.62	.....
6	1.55	1.8	4.1	2.35	1.75	.....	22	1.58	3.1	2.75	1.92	1.62	.....
7	1.55	1.8	3.95	2.35	1.72	.....	23	1.58	3.2	2.92	1.92	1.62	.....
8	1.55	1.8	3.95	2.08	1.72	.....	24	1.58	3.2	2.88	1.9	1.62	.....
9	1.55	1.8	3.95	2.02	1.72	.....	25	1.58	3.2	2.88	1.92	1.62	.....
10	1.55	1.8	4.05	2.02	1.72	.....	26	1.58	3.2	2.82	1.92	1.62	.....
11	1.62	1.8	4.05	1.98	1.72	.....	27	1.58	3.2	2.8	1.92	1.62	.....
12	1.68	1.85	4.75	1.98	1.72	.....	28	1.65	3.5	2.75	1.88	1.64	.....
13	1.68	1.82	4.55	1.98	1.72	.....	29	1.65	3.62	2.75	1.88	1.62	.....
14	1.58	1.88	4.35	1.98	1.72	.....	30	1.65	3.95	2.75	1.88	1.58	.....
15	1.58	1.88	4.15	1.98	1.72	.....	31	.....	4.05	.....	1.88	1.58	.....
16	1.58	1.88	3.95	1.98	1.72	.....							

NOTE.—Gage heights estimated June 11–19.

Station rating table for McIntyre Creek at Gleneyre, Colo., from April 1 to September 3, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	5	2.40	92	3.30	212	4.20	340
1.60	11	2.50	105	3.40	226	4.30	355
1.70	18	2.60	118	3.50	240	4.40	370
1.80	26	2.70	131	3.60	254	4.50	385
1.90	35	2.80	144	3.70	268	4.60	400
2.00	45	2.90	157	3.80	282	4.70	415
2.10	56	3.00	170	3.90	296	4.80	430
2.20	68	3.10	184	4.00	310		
2.30	80	3.20	198	4.10	325		

The above table is applicable only for open-channel conditions. It is based on twelve discharge measurements made during 1904–5, and is well defined between gage heights 1.6 feet and 3.2 feet.

Estimated monthly discharge of McIntyre Creek at Gleneyre, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	14	6	10.1	601
May	318	22	98.2	6,038
June	422	138	263	15,650
July	138	26	52.5	3,228
August	28	10	17.0	1,045
The period				26,560

SOUTH PLATTE RIVER.

DESCRIPTION OF BASIN.

The headwaters of the South Platte have their sources in the mountainous region surrounding the large basin near the center of the State of Colorado known as South Park and in the long eastern slopes of the high mountains forming the Continental Divide. The general course of the stream is eastward to Lake George, thence through Platte Canyon northward to the junction with Cache la Poudre River near Greeley, and thence eastward until it joins the North Platte at the town of North Platte, Nebr.

The drainage basin, which is about 20,000 square miles in extent above Julesburg, Colo., is bisected in an irregular way by the channel of the South Platte. To the north and west lies the mountainous portion, which consists of a long, narrow strip lying in a north-south direction along the foothills from a point a short distance within Wyoming to Palmer Lake, Colo. This area produces at least 90 per cent of the total run-off of the basin. South and east of the river the basin lies entirely within the plains region.

The mountainous region consists of peaks and jagged masses of granite, with sedimentary rocks cut and gashed by stream channels along the foothills. The stream gradients are steep, and many of the streams consist of series of cascades and rapids. The soil cover as a whole is light, and except during spring freshets or heavy storms the streams are remarkably free from sediments in suspension. The forest cover of the mountains, consisting originally of coniferous trees, is rapidly disappearing, but through the occurrence of fires a foothold has been furnished for the deciduous aspen, which is gradually increasing its dominion. The South Platte, Plum Creek, and Medicine Bow forest reserves are in part comprised within this area.

The lower basin, somewhat broken and scarred along the foothills, gradually merges farther east into the undulating prairies so characteristic of the Great Plains east of the Rocky

Mountains. The soils of the plains are the product of the disintegration of shales and sandstones of the Laramie formation and range from adobe clays to sandy loams. The controlling vegetation is largely native grasses, the only timber being a few bunches of scraggly cottonwoods along the stream channels and small patches of pine, cedar, and piñon along the higher portions.

Precipitation varies from 25 inches along the Continental Divide, where the greater part of it is snowfall, to 14 to 17 inches among the foothills. Evaporation records are meager.

In the mountainous region the flow of the South Platte and its tributaries is perennial; but in the plains area the volume is greatly diminished, owing to the fact that the normal waters are completely diverted for irrigation, the acreage capacity of the canals far exceeding the capacity of the river. At North Platte, Nebr., just above the mouth of the river, the stream channel is dry for the greater part of the year or consists of several small channels carrying a few second-feet of water.

The tributaries of the South Platte comprise, first, the small streams that rise on the eastern slopes of the Rocky Mountains, and, second, the plains streams. The mountain streams furnish a perennial supply of water, the amount of which, however, varies with the snowfall, being light during the latter part of the summer and in the fall and winter, and large during the spring floods. This water is almost entirely diverted for irrigation and does not reach the South Platte except in times of heavy floods. The principal streams of this class are Bear, Clear, Boulder, and St. Vrain creeks and Big Thompson and Cache la Poudre rivers. The plains streams are all intermittent in their nature and furnish water only during storms or in the season of melting snow. The chief streams of this class are Cherry, Lone Tree, Kiowa, Boxelder, Bijou, Beaver, and Pawnee creeks.

The South Platte is subject to periodic floods, which occur in May and June, the magnitude varying from year to year with seasonal precipitation and temperature. At Julesburg, on the eastern margin of the basin in Colorado, the stream may vary from no flow up to 12,000 second-feet.

Information in regard to this basin is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 159; 19, iv, p 311; 20, iv, pp 277-279; 21, iv, p 200; Bull 140, pp 102-103.
Drainage areas: Bull 140, p 103.
Irrigation surveys: Ann 13, iii, pp 82-91.
Rainfall and river stations, map: WS 75, p 131.
Rainfall data: WS 75, pp 131-135, 137. *See also* WS 74.
Water-storage possibilities: Ann 22, iv, pp 314-317.

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station was established March 28, 1902, at the wagon bridge crossing the South Platte about 150 feet below the junction of North and South forks at the town of South Platte, a station on the Colorado and Southern Railway about 9 miles above the mouth of the canyon. May 7, 1905, the old station was abandoned and a new station established at a point 150 feet below the county bridge. The station is very near the Colorado and Southern Railway station and is easily accessible from Denver.

This station is of special importance, its location being above the diverting gates of all irrigating ditches and also above the intake of the Denver Union Water Company, which derives the greater part of its supply from the South Platte, a few miles below. The location of the Cheesman storage reservoir on the South Fork 20 miles above this station and the contemplated installation of large power plants on the two forks at points above also add to the importance of the station as a base from which to secure data. Bridges across each fork above the main station allow of measurements being made on these streams, thereby checking all gagings on the main stream.

At the wagon bridge the channel is straight for 250 feet above and 400 feet below. The right bank is the side of the mountain. At ordinary stages the left bank is part of the old river bed, about 100 feet wide. At extremely high water the Colorado and Southern road-

bed forms the left bank. The stream is divided into two channels by the central pier of the bridge, the right channel being the deeper and carrying most of the water. The current is rough and rapid beneath the bridge, but becomes more even below. An old abutment foundation directly under the left end of the bridge interferes with the current at high stages.

At the station established May 7, 1905, the channel is straight for about 150 feet above and 75 feet below the cable section and is fairly uniform in width. The right bank is composed of granite bowlders and stands about 12 feet above low water. The left bank is the Colorado and Southern Railway embankment and is lined with a light growth of willows. Each bank has a slope of about 45°, and neither overflows. The bed of the stream is composed primarily of granite bowlders, the interstices being filled in with cobblestones and gravel. Upon this bed a loose deposit of disintegrated granite shifts constantly. During high water this deposit is entirely scoured out, but is immediately replaced with decreased flow. There is but one channel at all stages. The current is swift at high water and moderate at low. During extreme cold weather the channel is entirely covered with ice, but owing to the high gradient and the shifting bed accurate gage heights can not be obtained.

At the original station high-water measurements were made from the lower side of the two-span highway bridge to which the gage was attached, the initial point for soundings being the river face on the right abutment. At a gage height of 2.3 feet or less measurements were made by wading about 250 feet below the bridge.

Discharge measurements at the new station are made by means of a car, cable, and tagged and stay lines. The initial point for soundings is the zero on the tagged wire, about halfway between low water and the top of the right bank. At low water discharge measurements may be made by wading.

The original gage consisted of a vertical timber, reading from zero to 7 feet, fastened to the upper side of the center pier of the highway bridge. This gage was referred to a regulation metal bench-mark tablet in the cliff about 75 feet from the south end of the bridge; elevation, 18.43 feet above zero of gage.

The gage established May 7, 1905, was read twice daily, morning and evening, by Miss E. H. Jardine. It consists of an inclined staff, graduated from 1 foot to 9 feet, and is bolted to a bowlder on the right bank 100 feet above the cable. The bench mark is a standard United States Geological Survey tablet cemented into the top of a granite shelf near the south end of the cable and just above the gage rod; elevation, 17.63 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 84, pp 89-90; 99, pp 203-204; 131, pp 70-71.
Discharge: 84, p 90; 99, pp 204, 207; 131, p 72.
Discharge, monthly: 84, p 92; 99, p 206; 131, p 73.
Gage heights: 84, p 91; 99, pp 204-205; 131, p 72.
Rating tables: 84, p 91; 99, pp 205-206; 131, p 73.

Discharge measurements of South Platte River at South Platte, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 6[a]	R. I. Meeker				1.42	203
May 12	M. C. Hinderlider	78	271	4.42	3.75	1,197
May 24	M. P. Beeson	83	342	4.92	4.35	1,683
May 30	Hinderlider and Hoyt	82	296	4.22	4.02	1,249
June 9	M. P. Beeson	83	360	5.39	4.90	1,940
June 20	do	78	220	3.77	3.20	830
June 27	do	77	176	2.90	2.50	510
July 17	do	75	119	2.25	1.90	258
July 24	do	75	123	2.13	1.90	262
July 30	do	75	139	2.48	2.20	345
September 5	R. I. Meeker	76	103	2.78	2.18	286
September 5	do	75	121	3.02	2.40	365
September 6	M. P. Beeson	75	132	2.82	2.38	373
September 7	R. I. Meeker	75	119	2.87	2.32	342
September 12	do	75	100	2.69	2.10	269
September 13	do	75	98	2.74	2.10	269
October 20	do	74	73	2.16	1.67	158

[a] This is the sum of the measurements on two forks. The gage height is doubtful. The old gage recorded 1.62 feet.

Daily gage height, in feet, of South Platte River at South Platte, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.35	4.3	2.4	2.3	2.2	1.7	1.7
2		4.35	4.15	2.35	2.5	2.2	1.7	1.78
3		4.1	4.35	2.35	2.38	2.2	1.7	1.78
4		4.0	4.5	2.2	2.32	2.2	1.7	1.8
5		3.95	4.75	2.1	2.25	2.3	1.7	1.8
6	1.65	3.75	4.55	2.1	2.3	2.4	1.7	1.78
7	1.98	3.65	4.75	2.1	2.3	2.32	1.7	1.9
8	2.18	3.5	5.05	2.15	2.2	2.3	1.7	1.8
9	2.35	3.45	4.95	2.2	2.2	2.3	1.6	1.8
10	2.55	3.7	4.9	2.2	2.1	2.25	1.6	1.75
11	2.35	3.7	4.85	2.1	2.1	2.2	1.7	1.7
12	2.3	3.7	4.5	2.1	2.3	2.12	1.7	1.75
13	2.35	3.8	4.6	2.1	2.38	2.1	1.7	1.75
14	2.32	3.75	4.5	2.1	2.35	2.1	1.7	1.82
15	2.45	3.65	4.2	2.1	2.25	2.02	1.72	1.8
16	2.32	3.7	3.95	2.05	2.15	2.0	1.75	1.8
17	2.35	3.8	3.8	1.92	2.08	2.0	1.82	1.8
18	2.5	3.85	3.6	1.8	1.95	2.0	1.8	1.8
19	2.65	3.9	3.38	1.8	1.9	2.0	1.8	1.6
20	2.45	4.1	3.2	1.9	1.9	2.0	1.7	1.6
21	2.3	4.1	3.05	2.0	1.8	2.0	1.7	1.75
22	2.45	4.05	2.95	2.0	1.8	1.9	1.78	1.65
23	2.55	4.2	2.9	2.0	1.8	1.9	1.8	1.65
24	2.62	4.35	2.85	2.3	1.95	1.8	1.75	1.6
25	2.55	4.4	2.7	2.15	2.0	1.7	1.7	1.6
26	2.85	4.4	2.6	2.0	2.0	1.7	1.7	1.6
27	3.15	4.45	2.55	2.1	2.1	1.7	1.7	1.6
28	3.65	4.3	2.4	2.15	2.1	1.7	1.7	1.6
29	3.9	4.0	2.4	2.2	2.1	1.7	1.8	.....
30	4.05	3.95	2.4	2.2	2.3	1.7	1.8	.....
31	.....	4.0	.....	2.2	2.2	.....	1.75	.....

Station rating table for South Platte River at South Platte, Colo., from April 6 to July 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	185	2.50	495	3.40	950	4.30	1,550
1.70	210	2.60	540	3.50	1,010	4.40	1,625
1.80	240	2.70	585	3.60	1,075	4.50	1,700
1.90	270	2.80	630	3.70	1,140	4.60	1,775
2.00	305	2.90	680	3.80	1,205	4.70	1,850
2.10	340	3.00	730	3.90	1,270	4.80	1,930
2.20	375	3.10	780	4.00	1,340	4.90	2,010
2.30	415	3.20	835	4.10	1,410	5.00	2,090
2.40	455	3.30	890	4.20	1,480	5.10	2,170

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during the first part of 1905, and is fairly well defined between gage heights 1.9 feet and 5 feet. Owing to shifting conditions between July 24 and September 5 the rating tables have been applied indirectly.

Station rating table for South Platte River at South Platte, Colo., from August 1 to November 28, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	142	1.90	210	2.20	300	2.50	420
1.70	162	2.00	237	2.30	335	2.60	465
1.80	185	2.10	267	2.40	375		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during the latter part of 1905, and is well defined between gage heights 1.7 feet and 2.4 feet.

Estimated monthly discharge of South Platte River at South Platte, Colo., for 1905.

[Drainage area, 2,612 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 6-31	1,375	198	563	27,920	0.216	0.201
May	1,662	980	1,321	81,220	.506	.583
June	2,130	455	1,259	74,920	.482	.538
July	455	240	340	20,900	.130	.150
August	465	190	306	18,820	.117	.135
September	375	162	253	15,060	.097	.108
October	190	142	167	10,270	.064	.074
November 1-28	210	142	169	9,386	.065	.068
The period				258,500		

SOUTH FORK OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station was established May 8, 1905, for the purpose of collecting data in regard to the run-off of the South Fork drainage basin and also to furnish information concerning power and irrigation possibilities on the stream. It is located about 500 feet above the junction of North and South forks of South Platte River, in T. 7 S., R. 20 W., and is about 700 feet above the wagon bridge at which the old station on the South Platte was located.

The channel is straight for about 300 feet above and 150 feet below the station. The right bank is of loam and gravel and slopes up to a narrow strip of bottom land which is covered with cottonwood trees. The left bank is more abrupt and about 7 feet high; it is composed of gravel, but has a scant growth of vegetation. Both banks overflow at extreme high water. The bed of the stream is primarily of cobblestones, which are covered by a shifting deposit of disintegrated granite along the right bank. This deposit is comparatively uniform and even throughout. There is but one channel at all stages. The current is swift at high water and moderate at low water. Gage heights range from 1 foot to 6 feet.

Discharge measurements are made by means of a cable, car, and stay and tagged lines. The initial point for soundings is the zero of the tagged wire, which is located above ordinary high-water line on the right bank. Measurements at low water may be made by wading at the cable station.

The gage, which was read twice daily during 1905 by Miss E. H. Jardine, consists of an inclined timber firmly bolted in place to a cottonwood tree on the left bank. It is graduated from zero to 8.6 feet. The bench mark is a spike driven horizontally 1 foot above the ground into the east side of a 6-inch cottonwood tree to which the cable is fastened on the left bank; elevation above the zero of the gage, 8.19 feet.

Discharge measurements of South Fork of South Platte River at South Platte, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
April 6	R. I. Meeker	42	52	23.3	1.60	121
May 12	M. C. Hinderlider	59	171	4.87	3.48	833
May 23	M. P. Beeson	62	175	46.7	3.50	818
May 24	do	63	183	4.60	3.65	843
May 30	Hoyt and Hinderlider	60	156	4.26	3.20	665
June 9	M. P. Beeson	63	214	4.11	4.30	879
June 20	do	59	111	3.48	2.50	387
June 27	do	56	80	2.36	1.90	189
July 17	do	56	58	1.60	1.50	93
July 24	do	56	65	1.51	1.50	98
July 30	do	55	63	2.44	1.80	154
September 6	do	58	72	2.90	2.20	209
Do	R. I. Meeker	58	73	3.12	2.20	228
September 7	M. P. Beeson	58	79	2.85	2.17	225
Do	R. I. Meeker	58	75	3.03	2.16	227
September 12	do	56	66	2.83	2.00	187
September 13	do	56	65	2.77	1.97	180
September 14	do	55	62	2.68	1.90	166
October 19	do	54	51	2.18	1.60	111

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3.3	1.7	2.0	2.1	1.4	1.5
2	.....	3.3	1.65	2.2	2.2	1.4	1.6
3	.....	3.3	1.65	2.2	2.2	1.4	1.6
4	.....	3.65	1.55	2.18	2.2	1.4	1.6
5	.....	4.0	1.5	2.1	2.1	1.4	1.6
6	.....	4.0	1.5	2.1	2.3	1.4	1.6
7	.....	3.95	1.5	2.0	2.2	1.4	1.6
8	2.6	4.0	1.55	2.0	2.2	1.4	1.6
9	2.95	4.3	1.6	2.0	2.2	1.4	1.6
10	3.4	4.35	1.6	1.95	2.15	1.45	1.6
11	3.5	4.18	1.6	1.9	2.1	1.4	1.6
12	3.45	3.8	1.6	2.05	2.0	1.4	1.6
13	3.5	3.3	1.6	2.2	2.0	1.4	1.6
14	3.5	3.2	1.6	2.2	1.9	1.45	1.6
15	3.4	3.1	1.6	2.08	1.9	1.52	1.6
16	3.4	2.95	1.45	2.0	1.9	1.55	1.6
17	3.45	2.82	1.38	2.0	1.8	1.6	1.6
18	3.4	2.7	1.35	1.8	1.8	1.6	1.6
19	3.55	2.65	1.35	1.8	1.8	1.6	1.5
20	3.6	2.6	1.42	1.7	1.8	1.6	1.5
21	3.5	2.4	1.5	1.6	1.8	1.6	1.5
22	3.5	2.3	1.48	1.6	1.8	1.6	1.5
23	3.55	2.3	1.5	1.6	1.7	1.55	1.5
24	3.65	2.25	1.8	1.65	1.62	1.5	1.5
25	3.65	2.0	1.75	1.65	1.5	1.5	1.5
26	3.55	2.0	1.6	1.7	1.5	1.5	1.5
27	3.55	1.9	1.75	1.8	1.5	1.5	1.5
28	3.45	1.7	1.85	1.8	1.5	1.5	1.5
29	3.3	1.7	1.9	1.8	1.5	1.6	.....
30	3.2	1.7	1.9	2.0	1.5	1.6	.....
31	3.15	.....	1.9	2.05	.....	1.55	.....

Station rating table for South Fork of South Platte River at South Platte, Colo., from May 8 to November 28, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*	*Feet.*	*Sec. ft.*
1.30	70	2.10	215	2.90	505	3.70	980
1.40	80	2.20	240	3.00	560	3.80	1,045
1.50	95	2.30	270	3.10	615	3.90	1,110
1.60	110	2.40	300	3.20	670	4.00	1,175
1.70	125	2.50	335	3.30	730	4.10	1,240
1.80	145	2.60	370	3.40	790	4.20	1,310
1.90	165	2.70	410	3.50	850	4.30	1,380
2.00	190	2.80	455	3.60	915	4.40	1,450

The above table is applicable only for open-channel conditions. It is based on fifteen discharge measurements made during 1905, and is fairly well defined between gage heights 1.5 feet and 3.5 feet. The table has been extended beyond these limits.

Estimated monthly discharge of South Fork of South Platte River at South Platte, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 8-31	948	370	798	37,990
June	1,415	125	638	37,960
July	165	75	112	6,887
August	240	110	176	10,820
September	270	95	171	10,180
October	110	80	93.4	5,743
November 1-28	110	95	104	5,776
The period				115,400

SOUTH PLATTE RIVER AT DENVER, COLO.

In the spring of 1895 a river station was established at the Twenty-third Street Viaduct in the city of Denver, but observations were discontinued June 18 of the same year, as the location was found to be unfavorable for accurate measurements and the water had fallen below the gage. In July, 1895, a station was established at the Fifteenth Street Bridge. The present station is located at a point immediately below the mouth of Cherry Creek, which enters between the Fourteenth and Fifteenth street bridges.

The station is important principally from the fact that it is used as a training station for the instruction of young hydrographers in the field use of current meters.

The channel is straight at low water for 100 feet above and 500 feet below the gage rod and at high water for several blocks each way from the Fifteenth Street Bridge. The average section of the bridge is 200 feet in width, confined by slag levees which overflow only in extreme floods. There is but one channel at all stages. The current is sluggish at low water and swift at high water. Gage heights range from 0.5 foot to 6 feet.

Discharge measurements are made at low water by wading at a point above or below the gage; high-water measurements are made from the 200-foot single-span steel bridge at Fifteenth street, the initial point for sounding being the edge of the right abutment of the bridge.

During 1905 the gage was read twice each day by Clarence Crisman. The original gage consisted of inclined timbers fastened to posts driven into the bank. In August, 1898, another inclined gage rod, reading the same as the one on the right bank, was placed on the left side. This gage rod was washed out by the high water of June, 1900, which also removed the sand bar in front of the rod on the right hand side, making it available at low-water stages, and since that time readings have been taken from the latter rod or from rods which replaced it and were located at the same point. May 15, 1901, a T rail was placed on the site of the right-bank rod, which had been stolen. This rail was embedded in an inclined position in the slag bank. All readings were taken from this rail from May 15, 1901, to June 9, 1903, when it was stolen. June 10, 1903, a vertical timber was placed at the same point and fastened to a cottonwood tree, the zero of the rod being set at the same elevation as the zero of the old gage. The gage is located on the right bank about 60 feet above the Sixteenth Street Viaduct; the rod is graduated from zero to 7 feet. The original bench mark is a cross on top of the east abutment of the Fifteenth Street Bridge, on the north corner, 107 feet southwest of the gage; it is marked "B. M.," and its elevation is 6.15 feet above the 9-foot mark on the original Fifteenth street gage rod, which has since been destroyed. The bench mark for the present gage is a cross cut in the capstone of the south end of the south abutment of the right masonry pier of the Sixteenth Street Viaduct; elevation, 11.90 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull.=Bulletin; WS=Water-Supply Paper.

Description: Ann 18, iv, pp 162-163; Bull 140, pp 104-105; WS 15, p 88; 27, p 77; 37, p 225; 49, p 281; 66, p 30; 84, pp 86-87; 99, pp 199-200; 131, pp 74-75.

Discharge: Ann 13, iii, p 85; 18, iv, p 163; Bull 140, p 105; WS 15, p 88; 27, p 86; 37, p 225; 49, p 281; 66, p 30; 84, p 87; 99, p 201; 131, p 75.

Discharge, daily: WS 131, p 76.

Discharge, monthly: Ann 18, iv, p 165; 19, iv, p 314; 20, iv, pp 263, 279; 21, iv, p 202; 22, iv, p 319; Bull 140, p 106; WS 75, pp 127, 136; 84, p 88; 99, p 203; 131, p 77.

Discharge, yearly: Ann 20, iv, p 54.

Gage heights: Bull 140, p 105; WS 11, p 53; 15, p 88; 27, p 84; 37, p 226; 49, p 282; 66, p 30; 84, p 88; 99, pp 201-202.

Hydrographs: Ann 13, iii, p 85; 18, iv, p 166; 19, iv, p 314; 20, iv, p 280; 21, iv, p 202; 22, iv, p 319.

Rainfall and run-off relation: Ann 20, iv, p 266; WS 75, p 137.

Rating tables: Ann 18, iv, pp 164-165; 19, iv, p 313; Bull 140, p 105; WS 27, p 89; 39, p 448; 52, p 517; 66, p 171; 84, p 88; 99, p 202.

Discharge measurements of South Platte River at Denver, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 25	M. P. Beeson	60	91	2.91	1.75	265
March 4 [a]	do	64	81	2.0	1.40	162
March 11	do	50	61	1.36	1.00	83
Do	do	50	61	1.34	1.00	82
March 25	do	55	90	2.39	1.41	215
April 4	do	89	155	3.09	2.11	479
April 8	do	92	155	3.67	2.30	569
April 8 [a]	do				2.30	555
April 15	do	90	154	3.56	2.20	549
April 22	do	90	186	3.56	2.45	662
April 25	do	184	322	4.15	3.10	1,335
April 27	do	185	404	4.53	3.42	1,840
May 5	do	166	389	4.49	3.20	1,747
June 10	do	175	441	3.93	3.00	1,732
June 29	do	162	188	2.40	1.86	451
July 12	do	140	121	2.08	1.45	252
July 29 [a]	do	105	132	2.28	1.50	301
September 16	do	129	105	1.71	1.25	180
November 4	W. A. Lamb	92	59	2.15	1.00	127
November 14 [a]	do	62	58	1.69	.90	98
November 25 [a]	do	68	49	1.88	.84	92
December 8	do	94	82	1.85	1.29	152

[a] Made at different section.

Daily gage height, in feet, of South Platte River at Denver, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	0.88	1.55	1.75	3.5	3.0	1.8	1.85	1.18	0.8	0.95	0.75
2	.88	.78	1.48	2.05	3.48	3.0	1.8	1.82	1.25	.75	.95	.7
3	.9	.72	1.5	2.15	3.52	3.02	1.72	1.75	1.25	.75	.9	.7
4	.9	.7	1.4	1.95	3.5	3.2	1.65	1.7	1.35	.78	.9	.7
5	.9	1.0	1.35	1.95	3.4	3.4	1.58	1.6	1.42	.8	.9	.75
6	.9	1.0	1.35	2.05	3.25	3.25	1.42	1.6	1.55	.75	.9	.8
7	.9	.9	1.45	2.22	3.12	3.08	1.5	1.5	1.4	.8	.9	.8
8	.88	.9	1.4	2.35	3.12	3.02	1.7	1.45	1.3	.8	.95	1.1
9	.8	.82	1.15	2.52	3.18	3.02	1.68	1.35	1.35	.8	.98	1.25
10	.75	.78	1.0	2.7	3.5	3.05	1.6	1.38	1.35	.75	.9	1.0
11	.72	.72	1.0	2.85	3.42	3.0	1.5	1.58	1.32	.75	.9	.9
12	.65	.7	1.0	2.45	3.4	3.0	1.42	1.55	1.45	.78	.9	.88
13	.6	.7	.95	2.25	3.42	2.6	1.45	1.55	1.3	.88	.95	.85
14	.6	.75	.95	2.2	3.38	1.95	1.25	1.5	1.15	.92	1.0	.82
15	.6	.8	1.05	2.3	3.3	1.82	1.22	1.5	1.12	1.05	.92	.8
16	.7	.8	1.18	2.25	3.3	1.8	1.28	1.4	1.1	1.15	.9	.8
17	.98	.85	1.25	2.25	3.3	1.82	1.05	1.25	1.15	1.22	.9	.8
18	1.55	.9	1.35	2.25	3.35	1.82	.98	1.2	1.15	1.25	.9	.8
19	1.2	1.02	1.45	2.3	3.35	1.6	1.12	1.15	1.05	1.28	.9	.8
20	1.0	1.22	1.9	2.28	3.42	1.6	1.15	.98	1.02	1.2	.9	.8
21	1.0	1.45	1.75	2.32	3.5	1.5	1.28	1.02	1.0	1.1	.9	.8
22	1.0	1.75	1.7	2.35	3.5	1.5	1.4	1.0	1.08	.75	.85	.8
23	1.12	1.88	1.55	2.6	3.48	2.0	1.55	.95	1.0	.9	.82	.8
24	1.18	1.78	1.45	2.8	3.45	2.08	1.52	.92	.92	.9	.82	.82
25	1.12	1.68	1.15	3.08	3.4	2.02	1.42	1.0	1.0	.85	.8	.82
26	1.12	1.65	1.1	3.1	3.38	2.1	1.42	1.02	1.02	.82	.8	.78
27	1.18	1.5	1.25	3.4	3.45	2.05	1.48	1.05	1.05	.82	.8	.7
28	1.1	1.42	1.45	3.55	3.32	2.0	1.5	1.02	1.02	.9	.8	.7
29	.95	.....	1.5	3.5	3.22	1.8	1.5	1.02	1.02	.8	.8	.68
30	.95	.....	1.35	3.55	3.0	1.8	1.55	1.02	1.12	.9	.8	.7
31	.9	.....	1.35	.....	3.0	.....	1.75	1.08	.....	1.0	.....	.7

Daily discharge, in second-feet, of South Platte River at Denver, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	87	77	196	330	2,014	1,392	410	440	167	92	115	72
2	84	64	175	455	1,982	1,392	410	426	184	84	115	65
3	87	57	169	505	2,046	1,420	378	398	184	84	106	64
4	87	55	159	410	1,014	1,685	350	378	214	88	106	63
5	87	95	149	410	1,854	1,998	322	338	235	92	106	68
6	87	95	149	455	1,745	1,760	260	338	282	84	106	69
7	87	79	169	542	1,434	1,505	290	298	229	92	106	69
8	84	79	159	620	1,434	1,420	370	278	199	92	115	115
9	73	69	110	736	1,520	1,420	362	242	214	92	121	145
10	73	64	85	890	2,014	1,462	330	252	214	84	106	98
11	62	56	82	1,045	1,934	1,434	282	322	199	84	101	81
12	54	54	82	685	1,902	1,434	252	310	238	88	101	78
13	50	54	78	560	1,934	950	263	310	193	88	110	74
14	50	59	78	530	1,870	485	199	290	157	112	119	70
15	50	65	96	590	1,745	422	190	290	151	137	105	68
16	59	65	119	560	1,745	414	208	252	147	157	101	68
17	98	72	139	560	1,745	422	151	205	157	171	101	68
18	226	78	165	560	1,822	422	137	190	157	178	101	68
19	139	96	202	590	1,822	334	165	175	137	187	101	68
20	101	96	366	578	1,934	334	171	141	131	167	101	68
21	98	175	314	602	2,110	302	220	143	127	147	101	68
22	98	270	302	620	2,110	302	260	139	143	84	93	68
23	112	322	249	800	2,078	520	318	129	127	108	88	68
24	131	282	220	990	2,030	566	306	123	137	108	88	70
25	119	246	149	1,324	1,950	530	266	139	127	100	85	70
26	119	235	135	1,350	1,918	578	266	143	105	95	82	65
27	131	190	165	1,790	2,030	548	290	149	92	95	82	56
28	115	169	220	2,030	1,822	520	298	143	88	108	81	56
29	90	.....	235	1,950	1,670	422	298	143	84	92	79	54
30	90	.....	220	2,030	1,350	422	318	143	92	92	78	56
31	82	.....	190	.....	1,350	.....	398	163	.....	127	.....	56

NOTE.—The daily discharge was obtained by the indirect method.

Estimated monthly discharge of South Platte River at Denver, Colo., for 1905.

[Drainage area, 3,840 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	226	50	93.9	5,774	0.024	0.028
February	322	54	118	6,553	.031	.032
March	366	78	172	10,580	.045	.052
April	2,030	330	837	49,800	.218	.243
May	2,110	1,350	1,836	112,900	.478	.551
June	1,998	302	894	53,200	.233	.260
July	410	137	282	17,340	.073	.084
August	440	123	240	14,760	.062	.071
September	282	84	164	9,759	.043	.048
October	187	84	110	6,764	.029	.033
November	121	78	100	5,950	.026	.029
December	145	54	71.8	4,415	.019	.022
The year	2,110	50	410	297,800	.107	1.45

SOUTH PLATTE RIVER NEAR KERSEY, COLO.

This station was established April 7, 1901. It is located at a bridge about 1½ miles north of the railroad station at Kersey, which is on the Union Pacific Railroad about 6 miles east of Greeley, in T. 5 N., R. 64 W., and was intended to take the place of the station previously maintained at Orchard, Colo. The station was discontinued in the fall of 1903, but was reestablished March 5, 1905, to satisfy the demand for hydrographic data pertaining to the storage of flood waters. The station is below all the important tributaries of the South Platte which derive their supply from the mountain region and is at about the point where water could be used to best advantage for storage in reservoirs along the South Platte in northeastern Colorado.

The channel is straight for 300 feet above and 400 feet below the station. The banks are composed of alluvial material, and vary from 5 to 8 feet in height. The right bank is high and is not liable to overflow except at extremely high water. The left bank is low and not well defined, as it extends into high timber and overflows at extreme flood stages. The stream bed is composed of shifting sand and gravel. The channel is entirely covered only at extreme high water. At ordinary stages there are two channels and at low water the stream runs very close to the right bank. Scattered trees and brush dot the portion of the bed to the left of the center of the channel. Pile bents with 20-foot centers interfere at low water by catching drift and also by causing eddy water. The current is fairly swift at high stages and moderate at low. Gage heights range from 2 to 8 feet on the gage.

Discharge measurements are ordinarily made from the downstream side of the bridge, but at low water measurements are occasionally made by wading. The initial point for soundings is the north face of the right abutment of the bridge on the downstream side. The bridge is of piling, and is about 15° askew.

The gage, which was read once each day by E. K. Plumb, consists of a vertical staff graduated from zero to 8 feet, spiked to the downstream side of the third pile of the bridge from the south end. There is no bench mark, but a spike has been driven at each foot mark into the pile, to which the gage is attached.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 66, p 37; 84, p 77; 99, pp 183-184.
Discharge: 66, p 38; 84, p 77; 99 p 184, 207.
Discharge, monthly: 75, pp 130, 136; 84, p 79; 99, p 186.
Gage heights: 66, p 38; 84, p 78; 99, pp 184-185.
Hydrograph: 75, p 132.
Rating tables: 66, p 171; 84, p 78; 99, p 185.

Discharge measurements of South Platte River near Kersey, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 6	M. C. Hinderlider	490	1,580	3.82	6.22	6,032
June 1	Brick and Beeson	529	1.947	3.73	6.80	7,274
July 11	M. P. Beeson	141	172	1.09	2.40	188
October 3	M. C. Hinderlider	131	142	1.18	2.50	168
October 12 [a]	do	125	130	2.02	2.72	262

[a] Made at different section.

Daily gage height, in feet, of South Platte River near Kersey, Colo., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.5	6.3	6.8	2.6	2.75	2.3	2.5	3.2	2.9
2	2.4	3.0	6.1	6.9	2.55	2.75	2.3	2.5	3.3	2.9
3	2.4	3.6	6.22	6.9	2.5	2.5	2.3	2.5	3.3	2.9
4	2.5	3.4	6.5	6.8	2.45	2.5	2.3	2.5	3.3	2.85
5	2.5	3.4	6.35	6.8	2.4	2.5	2.3	2.5	3.3	2.85
6	2.5	3.4	6.3	6.9	2.4	2.4	2.35	2.5	3.3	2.85
7	2.5	3.4	6.25	7.0	2.4	2.4	2.35	2.5	3.3	2.8
8	2.5	3.2	6.2	7.5	2.4	2.4	2.4	2.5	3.0	2.8
9	2.45	3.3	6.1	7.4	2.35	2.4	2.4	2.5	2.95	2.75
10	2.4	3.3	6.0	7.2	2.35	2.4	2.4	2.6	2.95	2.75
11	2.4	3.7	6.0	7.2	2.35	2.4	2.4	2.65	2.9	2.75
12	2.4	3.9	6.1	6.0	2.35	2.5	2.4	2.7	2.9	2.75
13	2.4	4.0	6.0	5.8	2.3	2.5	2.4	2.8	2.9	2.75
14	2.4	4.0	5.95	5.5	2.3	2.45	2.4	2.9	2.9	2.8
15	2.4	3.9	5.9	5.0	2.3	2.45	2.4	2.9	2.85	2.8
16	2.45	3.9	5.85	5.0	2.3	2.45	2.4	2.9	2.85	2.8
17	2.5	3.8	5.8	5.0	2.35	2.45	2.4	2.9	2.8	2.75
18	2.6	3.8	5.7	4.5	2.35	2.4	2.4	2.9	2.8	2.75
19	2.55	3.9	5.8	4.0	2.35	2.4	2.4	2.9	2.8	2.75
20	2.5	3.9	6.0	3.5	2.35	2.4	2.4	2.9	2.8	2.75
21	2.55	3.9	6.0	3.2	2.35	2.4	2.4	2.95	2.8	2.75
22	2.6	4.0	6.0	3.1	2.35	2.35	2.4	2.95	2.8	2.75
23	3.0	3.8	7.75	3.0	2.35	2.35	2.4	2.95	2.85	2.75
24	3.0	4.25	7.0	3.0	2.35	2.35	2.4	2.95	2.85	2.75
25	2.9	6.0	6.8	2.9	2.3	2.3	2.4	2.95	2.9	2.75
26	2.8	5.95	6.6	2.9	2.3	2.3	2.45	2.95	2.9	2.75
27	2.75	6.1	6.6	2.8	2.3	2.3	2.45	3.0	2.9	2.75
28	2.65	6.25	6.8	2.7	2.3	2.3	2.5	3.0	2.9	2.75
29	2.5	6.5	6.9	2.7	2.3	2.3	2.5	3.0	2.9	2.75
30	2.5	6.4	7.2	2.6	2.3	2.3	2.5	3.1	2.9	2.75
31	2.5	.....	7.25	.....	2.3	2.3	.....	3.1	.....	2.7

NOTE.—Gage heights estimated March 1-4.

Station rating table for South Platte River near Kersey, Colo., from March 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	140	3.50	1,200	4.70	3,160	5.90	5,410
2.40	160	3.60	1,340	4.80	3,340	6.00	5,610
2.50	190	3.70	1,490	4.90	3,520	6.20	6,010
2.60	230	3.80	1,640	5.00	3,700	6.40	6,420
2.70	280	3.90	1,790	5.10	3,890	6.60	6,840
2.80	350	4.00	1,950	5.20	4,080	6.80	7,260
2.90	440	4.10	2,120	5.30	4,270	7.00	7,680
3.00	550	4.20	2,290	5.40	4,460	7.20	8,110
3.10	670	4.30	2,460	5.50	4,650	7.40	8,550
3.20	800	4.40	2,630	5.60	4,840	7.60	8,990
3.30	930	4.50	2,800	5.70	5,030	7.80	9,450
3.40	1,060	4.60	2,980	5.80	5,220		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 and two during 1903, and is fairly well defined between gage heights 2.5 feet and 7 feet.

Estimated monthly discharge of South Platte River near Kersey, Colo., for 1905.

[Drainage area, 9,470 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March	550	160	227	13,960	0.024	0.028
April	6,630	190	2,348	139,700	.248	.277
May	9,335	5,030	6,301	387,400	.665	.767
June	8,770	230	4,084	243,000	.431	.481
July	230	140	154	9,469	.016	.018
August	315	140	170	10,450	.018	.021
September	190	140	160	9,521	.017	.019
October	670	190	383	23,550	.040	.046
November	930	350	533	31,720	.056	.062
December	440	280	339	20,840	.036	.042
The period				889,600		

SOUTH PLATTE RIVER NEAR JULESBURG, COLO.

This station was established April 2, 1902. It is located at the wagon bridge crossing the South Platte about 1 mile southeast of Julesburg, Colo., a station at the junction of the main line and the Denver branch of the Union Pacific Railroad.

As this is the last station on the South Platte in Colorado, and as it is also below all irrigation ditches taking water from the South Platte in Colorado with the exception of one, it is of considerable importance for obtaining data relative to the flow of return waters as well as to the natural flow of the main channel.

The channel is straight for 600 feet above and 400 feet below the bridge. The banks are composed of alluvial material and are likely to overflow. The bed, which is about half a mile wide, is composed of shifting sands and at ordinary stages the section is broken by islands covered with undergrowth and vegetation. As a result the stream flow is usually divided into a number of small threads, some of which are too small to measure and at low water are generally estimated. The bed of the stream is dry the larger part of the year. The current is swift during high water but moderate at low. Records are usually discontinued during the winter months.

High-water measurements are made from the bridge, which is one-half mile long and is supported on piles at intervals of 20 feet. The initial point for soundings is the north abutment on the left bank. At low water the flow is divided into a number of small channels which are measured by wading.

The gage, which was read during 1905 by Volney Parker, consists of a vertical staff spiked to a pile of the bridge about 1,600 feet from the north end on the downstream side. The bench mark is a spike driven into the south face of the cap timber on the piling to which the gage is spiked; it is directly over the gage, and is inclosed in a circle of white paint and marked "B. M.;" the elevation of the center of the spike above the zero of the gage is 8.00 feet. The gage is read once daily except during high water, when several observations may be made each day.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: WS 49, p 283; 84, pp 73-74; 99, p 179; 131, pp 77-78.
Discharge: Ann 20, iv, p 302; Bull 140, p 114; WS 49, p 283; 84, p 74; 99, p 180; 131, pp 78, 87.
Discharge, monthly: WS 84, p 75; 99, p 181; 131, p 80.
Gage heights: WS 84, p 74; 99, p 180; 131, p 79.
Rating tables: WS 84, p 75; 99, p 181; 131, p 79.

Discharge measurements of South Platte River, near Julesburg, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 6	T. W. Jenkins	1,523	2,253	2.50	3.75	5,643
May 10	M. C. Hinderlider	1,378	1,968	2.65	3.50	5,216
May 20	T. W. Jenkins	1,134	1,543	2.68	3.27	4,130
May 25	do	1,371	1,830	2.59	3.48	4,748
May 27	do	1,703	2,744	2.69	3.99	7,405
October 4[a]	M. C. Hinderlider	66	27	1.37	1.05	37

[a] Made by wading.

Daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1905.

Day.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.55	2.0	1.95	3.65	4.35	0.75	1.63	1.2	1.05	1.5	1.65
2	2.6	2.0	2.5	3.75	4.35	1.5	1.85	1.15	1.05	1.65	1.65
3	2.6	2.0	1.95	3.85	4.0	1.4	2.05	1.15	1.05	1.85	1.65
4	2.6	2.0	1.9	3.85	3.85	1.2	3.0	1.1	1.05	1.9	1.65
5	2.6	2.0	1.95	3.8	3.8	.7	2.8	1.15	1.05	2.0	1.9
6	2.7	2.15	1.95	3.75	3.85	.6	2.9	1.2	1.05	2.0	1.9
7	2.8	2.05	2.5	3.7	3.9	.55	2.75	1.2	1.05	2.0	1.9
8	2.8	2.1	2.5	3.75	4.0	.5	2.3	1.35	1.05	2.25	1.95
9	2.75	2.15	2.5	3.75	4.5	.5	2.2	1.15	1.05	2.0	2.0
10	2.7	2.0	2.1	3.6	4.0	.45	2.15	1.15	1.05	1.9	2.1
11	.....	2.0	2.15	3.45	4.95	.4	2.5	1.1	1.05	1.9	2.1
12	.....	2.5	2.25	3.35	4.95	.4	2.45	1.1	1.15	1.9	2.1
13	2.65	1.95	2.25	3.45	4.0	2.0	2.35	1.1	1.25	2.0	2.1
14	2.65	2.0	2.25	3.5	3.95	1.9	2.3	1.1	1.2	2.0	2.15
15	2.65	2.5	2.5	3.5	3.55	1.8	2.0	1.1	1.25	1.9	2.2
16	2.65	2.1	2.4	3.45	3.5	1.75	2.1	1.15	1.35	1.8	2.2
17	2.7	2.5	2.5	3.35	3.3	1.9	2.15	1.2	1.25	1.75	2.1
18	2.8	2.5	2.55	3.35	3.1	1.8	2.2	1.15	1.3	1.65	2.15
19	2.95	2.2	2.4	3.4	3.0	1.85	2.25	1.15	1.35	1.7	2.2
20	3.15	2.1	2.75	3.3	3.0	1.75	1.75	1.1	1.32	1.6	2.15
21	3.25	2.0	2.7	3.45	2.85	1.7	1.65	1.1	1.35	1.65	2.25
22	.....	1.9	2.65	3.45	2.4	2.0	1.6	1.1	1.4	1.6	2.2
23	.....	1.95	2.7	3.45	1.0	1.95	1.45	1.1	1.4	1.75	2.2
24	.....	1.95	3.5	3.5	.85	1.9	1.3	1.05	1.35	1.65	2.15
25	.....	1.9	3.2	3.5	.95	1.85	1.2	1.05	1.5	1.65	2.0
26	.....	1.9	3.1	4.0	1.0	1.7	1.15	1.05	1.5	1.65	2.1
27	.....	1.9	3.5	4.0	.95	1.65	1.1	1.05	1.45	1.65	2.1
28	.....	1.9	3.4	4.2	.95	1.6	1.1	1.05	1.5	1.65	2.2
29	.....	1.9	3.6	4.3	.95	1.65	1.1	1.0	1.5	1.65	2.2
30	.....	1.8	3.6	4.3	.9	1.75	1.12	1.15	1.5	1.65	2.2
31	.....	1.95	.....	4.35	.....	1.7	1.12	.....	1.5	.....	2.25

NOTE.—Gage heights estimated March 1–4.

Station rating table for South Platte River near Julesburg, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	9	1.60	175	2.80	2,140	4.00	7,450
0.50	10	1.70	230	2.90	2,490	4.10	7,950
0.60	12	1.80	295	3.00	2,870	4.20	8,460
0.70	15	1.90	375	3.10	3,270	4.30	8,970
0.80	19	2.00	470	3.20	3,690	4.40	9,490
0.90	24	2.10	590	3.30	4,130	4.50	10,010
1.00	30	2.20	730	3.40	4,580	4.60	10,530
1.10	37	2.30	890	3.50	5,040	4.70	11,060
1.20	50	2.40	1,080	3.60	5,510	4.80	11,590
1.30	70	2.50	1,300	3.70	5,980	4.90	12,120
1.40	98	2.60	1,550	3.80	6,460	5.00	12,650
1.50	131	2.70	1,830	3.90	6,950		

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1904-5, and is fairly well defined between gage heights 1 foot and 4 feet.

Estimated monthly discharge of South Platte River near Julesburg, Colo., for 1905.

[Drainage area, 20,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January (19 days)	3,910	1,425	2,018	76,050	0.098	0.069
March	1,300	295	581	35,720	.028	.032
April	5,510	375	1,903	113,200	.092	.103
May	9,230	4,130	5,913	363,600	.287	.331
June	12,380	24	4,804	285,800	.233	.260
July	470	9	199	12,240	.0097	.011
August	2,870	37	695	42,730	.034	.039
September	84	34	41.8	2,487	.0020	.0022
October	131	34	68.8	4,230	.0033	.0038
November	810	131	310	18,450	.015	.017
December	810	202	565	34,740	.027	.031
The period				989,200		

CLEAR CREEK AT FORKSCREEK, COLO.

Clear Creek rises on the eastern slope of the Rocky Mountains, flows eastward, and unites with the South Platte about 6 miles north of Denver. Its drainage basin comprises a narrow strip of exceedingly mountainous country, consisting entirely of granitic rocks, in many places barren of soil, covered with scattered patches of coniferous trees, such as pine, spruce, and fir, remnants of the once extensive forests of the area. The basin includes also a small portion of Great Plains territory. Two of Colorado's oldest mining districts lie wholly within this basin, and in these districts the water of the upper tributaries of Clear Creek is used to such an extent that the name has long since become a misnomer. From Forkscreek to Golden, a distance of 13 miles, the creek flows in a canyon and has a total fall of 1,225 feet, an average of 94 feet per mile. Before the stream leaves the canyon a large volume of water is diverted by the canals that wind sinuously along the steep, rocky canyon sides,

and the entire normal flow of the creek between Golden and Denver is used for the irrigation of lands in Clear Creek Valley.

The gaging station was established May 29, 1899. It is located at the United States Geological Survey bridge, just below the Colorado and Southern Railway bridge at the railroad station, in T. 33 S., R. 72 W.

The station is important because of its location above all diversions and also because of contemplated power development.

The channel is narrow and straight for 30 feet above and 150 feet below the station. The right bank is the side of the mountain; the left is the retaining wall of the Colorado and Southern Railway embankment; both banks are high and can not overflow. The bed of the stream is composed of cobblestones and bowlders, over which a shallow deposit of silt forms during low-water stages, which is scoured out at high water. There is but one channel at all stages. The current is swift at low water and very rapid at high water. The surface of the water is rough and high-water measurements are difficult to obtain. During the winter ice blocks the channel and interferes with gage readings.

Discharge measurements are made from a substantial single-span footbridge, to which the gage is attached. The initial point for soundings is a brass-headed nail in the hand rail at the end of the bridge, and is marked zero with white paint.

The chain gage, which was read twice each day during 1905 by C. W. Hoisington, was originally fastened to the retaining wall on the left bank 30 feet below the footbridge. July 19, 1905, the gage was removed to the footbridge on account of the settling of the crib work to which it was attached. The length of the chain is 19.37 feet. The bench mark is a standard aluminum cap set in the bowlder, to which the downstream stay line of the bridge is anchored on the right bank; elevation above the zero of the gage, 9.50 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 37, pp 228-229; 49, pp 285-286; 66, p 31; 84, p 84; 99, pp 197-198; 131, p 80.
Discharge: WS 37, p 229; 49, p 286; 66, p 31; 84, p 84; 99, p 198; 131, p 81.
Discharge, monthly: Ann 21, iv, p 205; 22, iv, p 322; WS 75, p 128; 84, p 86; 99, p 199; 131, p 82.
Gage heights: WS 37, p 229; 49, p 286; 66, p 32; 84, p 85; 99, p 198; 131, p 81.
Hydrographs: Ann 21, iv, p 205; 22, iv, p 322.
Rating tables: WS 39, p 448; 52, p 517; 66, p 171; 84, p 85; 99, p 199; 131, p 82.

Discharge measurements of Clear Creek at Forkscreek, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 14	T. E. Brick	29	32	4.12	2.23	132
June 2	M. P. Beeson	36	121	8.61	3.85	1,042
June 16	do	36	138	9.00	4.10	1,242
July 19	do	36	83	3.19	2.94	265
July 19	J. C. Stevens	36	85	4.22	2.94	359
July 27	M. P. Beeson	36	83	3.37	2.79	280
October 19	R. I. Meeker	28	28	2.57	1.74	72
October 19	do	28	26	2.23	1.62	58

Daily gage height, in feet, of Clear Creek at Forkscreek, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.83	2.7	3.96	3.45	2.68	2.23	2.03
2	1.83	2.78	3.99	3.4	2.62	2.23	1.98
3	1.83	2.8	4.14	3.4	2.62	2.23	1.98
4	1.73	2.8	4.39	3.35	2.58	2.2	1.93
5	1.68	2.6	4.59	3.38	2.58	2.16	1.9
6	1.83	2.66	4.49	3.32	2.58	2.16	1.88
7	2.03	2.66	4.49	3.32	2.6	2.13	1.86
8	2.08	2.7	4.56	3.3	2.62	2.13	1.88
9	2.05	2.86	4.59	3.28	2.58	2.13	1.83
10	2.13	2.8	4.52	3.22	2.5	2.1	1.83
11	2.03	2.86	4.36	3.12	2.84	2.08	1.82
12	2.18	2.86	4.39	3.12	2.7	2.08	1.82
13	2.18	2.83	4.32	3.18	2.5	2.08	1.82
14	2.18	2.8	4.24	3.3	2.5	2.06	1.77
15	2.16	2.72	4.22	3.35	2.48	2.03	1.77
16	2.16	2.76	4.22	3.32	2.48	2.03	1.77
17	2.16	2.89	4.15	3.32	2.52	2.03	1.85
18	2.2	3.09	4.08	3.35	2.4	2.03	1.85
19	2.2	3.16	4.05	3.2	2.3	2.03	1.77
20	2.13	3.26	3.95	2.95	2.3	2.0	1.72
21	2.1	3.44	3.95	2.92	2.25	1.98	1.72
22	2.16	3.59	3.88	2.88	2.25	1.98	1.75
23	2.16	3.64	3.82	2.82	2.22	1.98	1.72
24	2.13	3.69	3.78	2.82	2.25	1.98	1.62
25	2.16	3.56	3.78	2.82	2.22	1.98	1.57
26	2.26	3.59	3.65	2.78	2.25	1.98	1.67
27	2.5	3.64	3.55	2.78	2.25	1.98	1.67
28	2.6	3.76	3.52	2.82	2.24	1.98	1.67
29	2.6	3.79	3.5	2.72	2.24	1.98	1.67
30	2.6	3.76	3.45	2.7	2.22	1.98	1.57
31	.....	3.89	.....	2.7	2.21	.....	1.52

Station rating table for Clear Creek at Forkscreek, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	47	2.30	160	3.10	390	3.90	1,010
1.60	55	2.40	180	3.20	440	4.00	1,130
1.70	65	2.50	200	3.30	500	4.10	1,260
1.80	75	2.60	230	3.40	560	4.20	1,400
1.90	90	2.70	260	3.50	630	4.30	1,540
2.00	105	2.80	290	3.60	710	4.40	1,690
2.10	120	2.90	320	3.70	800	4.50	1,850
2.20	140	3.00	350	3.80	900	4.60	2,010

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905 and four older measurements. It is fairly well defined between gage heights 1.5 feet and 4 feet.

Estimated monthly discharge of Clear Creek at Forkscreek, Colo., for 1905.

[Drainage area, 345 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	230	63	131	7,795	0.380	0.424
May	999	230	472	29,020	1.37	1.58
June	1,994	595	1,291	76,820	3.74	4.17
July	595	260	420	25,820	1.22	1.41
August	302	142	193	11,870	.556	.641
September	146	102	116	6,902	.336	.375
October	110	49	75.3	4,630	.218	.251
The period				162,900		

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements made in South Platte River drainage basin for 1905.

Date.	Stream.	Locality.	Area of section.	Mean velocity.	Discharge.
			Sq. ft.	*Ft. per sec.*	*Sec.-ft.*
March 31	South Platte	North Platte, Nebr.	236	1.62	382
June 14	do	do	2,781	2.74	7,614
July 13	do	do	89	1.92	170
April 8	Cherry Creek	Denver, Colo.			46

PLATTE RIVER.

DESCRIPTION OF BASIN.

From the point of junction of North and South Platte rivers the main stream winds eastward across Nebraska, uniting with the Missouri at Plattsmouth, about 10 miles south of Omaha. Its course lies for the most part through a broad, level bottom, rather sandy in places, but for the most part fertile, bordered by bluffs varying in height from 50 to 300 or 400 feet. From its source to a point near Ashland, Saunders County, it is a broad, shallow stream, flowing in many places as a network of interlacing channels among numerous islands and sand bars, but farther east it is confined between heavily wooded limestone bluffs.

The drainage basin lies wholly to the north of a line bordering closely the south bank of the stream and consists generally of rolling prairie land in the middle portion, which to the east and west gives way to extensive areas of sand hills. Along the main stream and its tributaries is a deep flood plain, composed of loam, sand, and gravel in the valleys and of talus on the slopes. Outside of this flood plain the soil is mostly loess, consisting of yellow clays and fine sandy loam. There is little timber except in the immediate vicinity of the small tributaries.

The average annual precipitation is about 23 inches, of which 69 per cent falls during the five months of the growing season, from April to August; about half of the remainder is snowfall. The stream is subject to periodic floods, caused by the melting of snows in the headwater regions of North and South Platte rivers; these floods reach a maximum in June and July and often do considerable damage to property on the lower portions of the stream. In the western part of the drainage area the waters of the river are extensively used for irrigation.

The principal tributaries of the Platte are the Elkhorn and the Loup, both draining long, narrow valleys north of the river.

Information in regard to the basin is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; W. S. Water-Supply Paper):

Description: Ann 12, ii, pp 238-239; 22, iv, p 306; Bull 131, p 28; WS 75, pp 124-125; 84, pp 50-51; 99, pp 137-138; 131, p 201.
Irrigation surveys: Ann 13, iii, pp 73-91.
Rainfall and river stations, map: Ann 20, iv, p 256.
Rainfall and run-off relation: Ann 20, iv, pp 265-266.
Rainfall data: Ann 13, iii, pp 76-77; 20, iv, pp 256-266.

PLATTE RIVER NEAR LEXINGTON, NEBR.

This station was established April 2, 1902. It is located at a highway bridge 3 miles south of Lexington, Nebr., in sec. 20, T. 9 N., R. 21 W.

The channel is straight both above and below the station. The banks are low and not liable to overflow, and the bed is composed of shifting sand. There are no obstructions in the channel other than the bridge piling, and the current is never sluggish, even at low water, when the stream some times flows in as many as forty channels of varying widths and depths. Gage heights have a range of about 3 feet. Records of winter flow are not obtained, as the river, on account of its shallowness, often freezes solid.

Discharge measurements are made from the upstream side of the highway bridge, which consists of 187 spans of 20 feet each, supported on piles. The initial point for soundings is the zero mark on the hand rail at the north (left) bank of the stream. A second, smaller channel, about one-fourth mile to the south, is measured from a similar pile bridge having a total span of 60 feet.

On account of the extreme width of the section (3,720 feet) and the shallowness of the stream, and also to partly eliminate the effect of wind, two gages are maintained at this station, the observer being E. J. Duryee, a mail carrier, who reads both gages as he crosses the bridge, no observations being taken on Sundays or holidays. The gages are of the standard chain type. One of them is located at the north end of the bridge, downstream side, and the other at the south end, upstream side, with their zeros at the same elevation. The wind sometimes creates a difference of over a foot between the two gages, but this difficulty is largely eliminated by using the means of the readings in computations of discharge. The zeros of the gages are referred to three bench marks: (1) The top of the east end of the first cap at the north end of the bridge; elevation, 7.66 feet. (2) The top of the upstream end of the cap of the third bent from the north end of the bridge, marked with a cross; elevation, 9.22 feet. (3) The top of the upstream end of the cap of the third bent from the south end of the bridge, marked with a cross; elevation, 9.03 feet. Bench mark No. 1 is 2,392 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, pp 59-60; 99, p 155; 131, pp 47-48.
Discharge: 84, p 60; 99, p 155; 131, p 48.
Discharge, monthly: 84, p 61; 99, p 157; 131, p 50.
Gage heights: 84, pp 60-61; 99, p 156; 131, p 49.
Rating tables: 84, p 61; 99, p 156; 131, p 49.

Discharge measurements of Platte River near Lexington, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 11	G. W. Bates	3,720	1,421	1.73	3.50	2,473
May 16	do	3,790	5,046	2.77	4.25	13,920
June 12	H. C. Gardner	3,720	8,223	3.14	4.93	25,830
July 10	do	3,800	4,705	2.34	3.93	11,010
July 18	do	2,900	1,681	1.71	3.38	2,882
August 2	do	3,140	1,765	1.63	3.48	2,877
August 23	H. O. Smith					0
September 6	H. C. Gardner	1,480	637	1.55	3.25	990
September 20	F. S. Dobson	1,540	502	1.61	3.10	760

Daily gage height, in feet, of Platte River near Lexington, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		3.45	4.2	4.9	4.05	3.6	3.15	3.15
2		3.52	4.2	4.9	4.25	3.48	3.2	3.18
3		3.58	4.28	4.9	4.48	3.6	3.2	3.15
4		3.62	4.3	4.85	4.33	3.55	3.2	3.15
5		3.62	4.32	4.8	4.18	3.48	3.35	3.15
6		3.62	4.32	4.65	4.05	3.45	3.25	3.15
7		3.6	4.36	4.55	4.2	3.42	3.22	3.15
8		3.55	4.4	4.5	4.08	3.42	3.2	3.16
9		3.48	4.35	4.5	4.0	3.45	3.2	3.18
10		3.4	4.35	4.75	3.92	3.5	3.16	3.12
11		3.45	4.42	4.82	3.92	3.35	3.12	3.1
12		3.42	4.52	4.9	3.85	3.3	3.12	3.18
13		3.52	4.52	4.8	3.82	3.3	3.15	3.15
14		3.5	4.44	4.72	3.75	3.32	3.12	3.25
15		3.5	4.35	5.0	3.65	3.38	3.12	3.26
16		3.5	4.25	5.15	3.6	3.42	3.28	3.28
17		3.52	4.28	5.05	3.55	3.45	3.33	3.3
18		3.55	4.25	4.95	3.42	3.3	3.38	3.3
19		3.52	4.22	4.82	3.40	3.28	3.32	3.32
20		3.52	4.3	4.78	3.42	3.28	3.28	3.28
21		3.72	4.3	4.68	3.4	3.28	3.28	3.28
22		3.82	4.3	4.58	3.62	3.42	3.3	3.3
23		3.85	4.2	4.75	3.56	3.4	3.3	3.3
24	3 55	3.88	4.15	4.7	3.5	3.28	3.25	3.3
25	3.42	4.05	4.12	4.55	3.42	3.25	3.2	3.3
26	3.45	4.12	4.25	4.42	3.42	3.25	3.2	3.32
27	3.45	4.15	4.3	4.32	3.4	3.22	3.18	3.3
28	3.38	4.15		4.2	3.32	3.18	3.15	3.32
29	3.42	4.12	4.75	4.12	3.38	3.2	3.1	3.35
30	3.50	4.16	4.72	4.1	3.42	3.18	3.12	3.38
31	3.50		4.78		3.45	3.18		3.4

NOTE.—Sunday and holiday gage heights interpolated. These gage heights are the mean of the two gages.

PLATTE RIVER NEAR COLUMBUS, NEBR.

This station was established June 4, 1895. It is located at the Meridian Bridge, about 3 miles south of Columbus, Nebr., in sec. 31, T. 17, R. 1 E. The bridge lies on the sixth principal meridian.

The river at this point flows in three channels, known as the main, middle, and south channels, having widths of 1,940 feet, 320 feet, and 75 feet, respectively, and each channel is spanned by a pile bridge. The main channel is crossed by the Meridian Bridge, which consists of sixty-five 30-foot spans; the middle-channel bridge consists of sixteen 20-foot spans, and is located 1⅛ miles south of the Meridian Bridge; the south channel is spanned by a pile bridge about 80 feet long, located one-eighth mile south of the middle-channel bridge.

Above the bridges the channels are straight for 5,000 feet in the main channel, 200 feet in the middle channel, and 100 feet in the south channel; below the bridges the channel is straight for 3,000 feet in the main channel, 300 feet in the middle channel, and 500 feet in the south channel. The sections are broad and shallow, with rapid velocity, and shifting, sandy beds. The banks are low but are not subject to overflow. At low stages the river flows in many shallow channels, so that the measurement of discharge is mainly a matter of estimation. A small tributary furnishes a supply of water in the south channel, even when the other channels are entirely dry. The only obstructions are the piling bents. Discharge measurements are made from the upstream side of all three bridges, whose hand rails are marked at intervals of 10 or 20 feet. The initial point for soundings is the zero mark on the upstream hand rail at the north end of the main-channel bridge and at the south ends of the middle and south channel bridges.

A standard chain gage, which is read by W. D. Benson, is fastened to the downstream hand rail of the Meridian Bridge approach. The length of the chain is 16.21 feet. The gage is referred to two bench marks, as follows: (1) A standard United States Geological Survey bench mark, located 60 feet north of the north end of the bridge truss and 10 feet west of a cottonwood tree 6 feet in diameter; elevation, 7.06 feet above the zero of the gage. (2) A bunch of three spikes driven in the top of the second piling from the downstream end of the second bent from the north end of the bridge, counting approach bent "one;" elevation, 9.62 feet above the gage datum. In past years deposits of sand about the gage have caused considerable trouble, and the records have been frequently interrupted.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 188; Bull 140, pp 121-122; WS 15, p 98; 27, p 78; 37, p 242; 50, p 307; 66, p 39; 84, p 57; 99, pp 152-153; 131, pp 50-51.

Discharge: Ann 18, iv, p 189; 20, iv, p 302; Bull 131, p 92; 140, p 122; WS 15, p 98; 27, p 87; 37, p 242; 50, p 308; 66, p 39; 84, p 58; 99, p 153; 131, p 51.

Discharge, daily: Ann 18, iv, p 190.

Discharge, flood: Ann 18, iv, pp 184-186.

Discharge, monthly: Ann 19, iv, p 334; 20, iv, pp 264, 295; 22, iv, p 329; WS 75, p 138; 84, p 59; 99, p 154; 131, p 53.

Discharge, yearly: Ann 20, iv, p 55.

Gage heights: Bull 140, p 122; WS 15, p 98; 27, p 85; 37, p 243; 50, p 308; 66, p 39; 84, p 58; 99, pp 153-154; 131, p 52.

Hydrographs: Ann 18, iv, p 190; 19, iv, p 334; 20, iv, p 296; WS 75, p 138.

Rainfall and run-off relation: Ann 20, iv, p 266.

Rating tables: Ann 18, iv, p 189; 19, iv, p 333; Bull 120, p 122; WS 39, p 449; 84, p 59; 99, p 154; 131, p 52.

Discharge measurements of Platte River near Columbus, Nebr., in 1905.

Date	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 16	Dobson, Bates, and Gardner	2,310	1,473	2.70	3.08	3,978
April 27	H. C. Gardner	2,330	4,153	3.28	4.45	13,630
May 16	do	2,300	7,384	4.52	5.60	33,410
June 21	do	2,280	7,256	3.79	5.10	27,570
July 8	do	2,285	5,899	3.36	4.45	19,760
July 14	do	2,295	3,336	2.55	3.50	8,514
August 12	do	1,660	1,060	2.31	2.25	2,341
September 27	F. S. Dobson	1,486	880	1.98	2.10	1,739
October 13	do	.....	586	1.52	1.80	891

Daily gage height, in feet, of Platte River near Columbus, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.6	4.8	5.35	4.6	2.75	1.5	1.7
2	.....	2.4	4.6	5.55	4.65	3.2	.75	1.55
3	.....	2.6	4.4	5.5	4.85	3.2	.7	1.5
4	.....	2.7	4.15	5.35	5.3	3.4	.75	1.5
5	.....	2.6	4.75	5.3	4.95	3.2	1.6	1.3
6	.....	3.0	5.6	5.2	5.5	3.25	1.8	1.3
7	.....	3.2	4.5	5.2	4.7	3.15	2.35	1.25
8	.....	3.1	4.4	5.2	4.55	3.0	2.85	1.2
9	.....	3.1	4.5	4.95	4.2	2.8	2.65	1.35
10	.....	2.9	4.3	5.25	4.15	2.5	2.4	1.2
11	.....	2.9	4.6	5.1	4.0	2.35	2.2	1.15
12	.....	2.8	4.55	5.3	3.75	2.25	1.9	1.15
13	.....	2.6	5.3	5.3	3.55	2.25	1.85	1.2
14	.....	2.7	5.75	5.25	3.35	2.2	2.6	1.35
15	.....	2.6	6.2	5.3	3.15	2.2	2.55	1.4
16	.....	2.6	5.45	5.3	3.0	2.25	2.2	1.3
17	3.1	2.8	5.6	5.8	2.85	2.5	2.25	1.35
18	3.6	2.8	5.15	5.35	2.7	2.55	3.5	1.3
19	3.2	2.8	4.6	5.45	2.5	2.6	3.45	1.35
20	3.8	3.4	4.55	5.15	2.3	2.35	3.35	1.4
21	3.7	3.8	4.35	5.15	2.3	2.35	3.25	1.5
22	3.6	4.0	4.35	4.95	2.2	2.25	3.15	1.6
23	3.7	4.2	4.25	6.35	2.25	2.3	3.0	1.65
24	3.5	4.4	4.2	5.4	2.1	1.95	2.95	1.85
25	3.3	4.6	4.1	5.25	2.1	1.9	2.45	2.0
26	3.1	4.8	4.25	5.25	2.85	2.1	2.2	1.9
27	3.0	5.0	4.15	5.3	3.15	2.2	2.05	1.9
28	2.8	5.3	4.45	5.0	2.85	1.75	1.9	2.0
29	2.7	5.15	5.1	4.95	2.7	1.55	1.75	2.5
30	2.6	5.1	5.25	4.85	2.65	1.35	1.7	2.5
31	2.6	.....	5.5	.....	2.6	1.15	.....	2.5

NOTE.—Gage heights estimated April 22-27.

Station rating table for Platte River near Columbus, Nebr., from March 17 to May 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	1,750	3.40	5,530	4.40	13,170	5.40	29,400
2.50	2,000	3.50	6,100	4.50	14,260	5.50	31,450
2.60	2,280	3.60	6,720	4.60	15,500	5.60	33,550
2.70	2,580	3.70	7,380	4.70	16,900	5.70	35,700
2.80	2,910	3.80	8,080	4.80	18,450	5.80	37,900
2.90	3,270	3.90	8,820	4.90	20,100	5.90	40,150
3.00	3,650	4.00	9,600	5.00	21,800	6.00	42,450
3.10	4,060	4.10	10,420	5.10	23,600	6.10	44,800
3.20	4,510	4.20	11,280	5.20	25,450	6.20	47,200
3.30	5,000	4.30	12,190	5.30	27,400		

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905. Owing to the shifting character of the stream bed, estimates based on the above table and on that following can only be considered rough approximations.

Station rating table for Platte River near Columbus, Nebr., from June 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	80	2.40	2,780	3.40	8,040	4.80	23,300
1.50	260	2.50	3,180	3.50	8,780	5.00	26,350
1.60	460	2.60	3,600	3.60	9,570	5.20	29,600
1.70	670	2.70	4,040	3.70	10,420	5.40	32,950
1.80	900	2.80	4,500	3.80	11,330	5.60	36,500
1.90	1,150	2.90	4,990	3.90	12,280	5.80	40 150
2.00	1,430	3.00	5,520	4.00	13,280	6.00	44,000
2.10	1,730	3.10	6,090	4.20	15,450	6.20	48,000
2.20	2,050	3.20	6,700	4.40	17,830	6.40	52,150
2.30	2,400	3.30	7,350	4.60	20,450		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905, and is fairly well defined between gage heights 1.8 feet and 5 feet. See note to preceding table.

Estimated monthly discharge of Platte River near Columbus, Nebr., for 1905.

[Drainage area, 56,870 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 17-31	8,080	2,280	4,914	146,200	0.086	0.048
April	27,400	1,758	7,800	464,100	.137	.153
May	47,200	10,420	19,360	1,190,000	.340	.392
June	51,100	24,050	31,180	1,855,000	.548	.611
July	34,700	1,730	10,770	662,200	.189	.218
August	8,040	0	3,217	197,800	.057	.066
September	8,780	0	2,978	177,200	.052	.058
October	3,180	0	604	37,140	.011	.013
The period				4,730,000		

LOUP RIVER AT COLUMBUS, NEBR.

The Loup and its branches, which form the most important tributaries of the Platte, drain an area 13,540 square miles in extent, lying in the heart of Nebraska. The Loup proper is formed by the junction of North and Middle Loup rivers, which unite near the city of St. Paul, the Middle Loup in turn receiving the South Loup in the southwestern part of Howard County. The principal tributaries are Beaver, Cedar, Calamus, and Dismal creeks.

The country drained is generally rolling, with an occasional high plain or table-land. The headwaters of the North and Middle Loup lie in a region of sand hills, among which are found numerous lakes varying in size from small ponds up to those with an area of several square miles. The immediate valleys of the streams are composed of alluvial deposits of sand, gravel, and loam, with areas of yellow clay and fine sandy loam beyond. The region abounds in springs, caused by the percolation of the precipitation through the sandy soil to the impervious clays below, and this fact no doubt accounts for the remarkable constancy of flow of the streams. The soil is generally fertile, and large quantities of hay, grain, etc., are grown. The streams are subject to a succession of floods during the spring and early summer, the result of melting snows and heavy rainfall in the spring months. As a large part of the area is grass grown, evaporation is considerable, averaging 5 feet.

A comparatively small amount of water is diverted for irrigation, the ditches generally being small and covering limited areas. A number of power plants are in operation, and others of considerable extent have been proposed, particularly one near Columbus, by which it is believed that about 20,000 continuous horse-power may be developed.

The gaging station was established October 13, 1894. It is located about 75 yards above the Union Pacific Railroad bridge and 6 miles above the mouth of the river, in sec. 23, T.17 N., R. 1 W.

At the measuring section the river is straight for about 1.000 feet above and a considerable distance below. The left bank is high; the right is low and overflows at high water. The bed is composed entirely of shifting sand. There is but one channel at all stages, and the current is rapid. The channel is unobstructed. At the lower gaging station the river flows chiefly in a deep channel near the right bank, obstructed by the piling of an old bridge a short distance below the existing highway bridge. Gage heights range from 3 to 12 feet, excessive floods being very rare and usually caused by ice gorges.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero-mark on the cable. In the spring of 1905 the cable at this station, which consisted of a five-eighths inch steel wire, was broken by the ice. Later in the season it was replaced by a new three-fourths inch steel cable. During the time that the cable was out measurements were made from the highway bridge or from the Union Pacific Railroad bridge near the station.

Two gages are maintained at this station—one a vertical staff spiked to piling at the cable, the other a standard chain gage at the highway bridge 1½ miles below. The gage heights here reported are those of the gage at the highway bridge, the observer being W. D. Benson. The length of the chain is 24.50 feet. These gages are referred to two bench marks as follows: (1) A standard United States Geological Survey bench mark, located 72 feet east of the upper gage; elevation 21.83 feet above the zero of the lower gage and 13.27 feet above the zero of the upper gage. (2) A cross cut on the west end of the cap of the first bent at the north end of the highway-bridge approach; elevation 10.91 feet above the zero of the lower gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Papers):

Description: Ann 18, iv, p 182; Bull 131, p 32; 140, p 118; WS 15, p 97; 27, p 78; 37 pp 240-241; 50, pp 306-307; 66, p. 38; 84, p 55; 99, p 145; 131, pp 82-83.

Discharge: Ann 18, iv, p 182; Bull 131, p 91; 140, p 118; WS 15, p 97; 27, p 87; 35, p 16; 37, p 241; 50, p 307; 66, p 38; 84, p 56; 99, p 146; 131, p 84.

Discharge, daily: Ann 18, iv, pp 183-184; 131, p 85.
Discharge, flood: Ann 18, iv, pp 184-186.
Discharge, monthly: Ann 18, iv, p 187; 19, iv, p 332; 20, iv, pp 263, 294; 22, iv, p 328; Bull 140, p 120; WS 75; p 137; 84, p 57; 99, p 147; 131, p 86.
Discharge, yearly: Ann 20, iv, p 55.
Gage heights: Bull 140, p 119; WS 15, p 97; 27, p 85; 37, p 241; 50, p 307; 66, p 39; 84, p 56; 99, p 146; 131 p 84.
Hydrographs: Ann 18, iv, p 184; 19, iv, p 333; 20, iv, p 295; 22, iv, p 328.
Rainfall and run-off relation: Ann 20, iv, p 266.
Rating tables: Ann 18, iv, p 183; 19, iv, pp 331-332; Bull 140, p 119; WS 39, p 449; 84, p 57; 99, p 147.

Discharge measurements of Loup River at Columbus, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 17	H. C. Gardner	820	1,046	4.45	4.40	4,659
May 4	do	295	870	5.72	4.55	4,982
May 16	do	740	2,162	5.96	5.90	12,890
June 21	do	660	1,695	3.13	4.65	5,316
July 8	do	800	2,040	4.54	5.30	9,263
July 14	do	540	1,144	3.60	4.80	4,126
August 12	do	800	1,945	2.62	4.20	5,089
September 27	F. S. Dobson	180	774	4.07	[a]4.03	3,153
October 13	do	330	965	4.26	4.18	4,113

[a] New rod; old rod read 4.30 feet.

Daily gage height, in feet, of Loup River at Columbus, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.3	4.6	5.2	6.85	4.8	4.4	4.25	4.2	.....
2	.....	4.4	4.55	5.0	6.25	6.8	4.35	4.4	4.15	.....
3	.....	4.5	4.7	5.5	6.7	5.9	4.3	4.35	4.1	.....
4	.....	4.9	4.6	5.0	6.55	5.0	4.3	4.3	4.1	.....
5	.....	4.6	4.75	4.7	5.85	4.75	4.5	4.2	4.25	.....
6	.....	4.4	4.85	4.65	5.7	4.4	4.6	4.2	4.5	.....
7	.....	4.2	4.8	4.35	5.8	4.45	4.85	4.2	4.35	.....
8	.....	4.1	4.7	4.25	5.4	4.5	4.85	4.2	4.3	4.5
9	.....	4.2	4.75	4.45	5.22	4.4	4.55	4.3	4.3	5.7
10	.....	4.3	5.6	4.35	5.0	4.35	4.5	4.3	4.35	5.7
11	.....	4.3	5.0	4.6	4.95	4.35	4.45	4.3	4.35	5.75
12	.....	4.2	4.9	4.6	4.9	4.3	4.4	4.3	4.4	5.7
13	.....	4.2	5.8	4.55	4.75	4.3	4.45	4.35	4.4	5.8
14	.....	4.3	6.35	4.45	4.5	4.25	4.95	4.4	4.45	6.5
15	.....	4.4	6.9	4.5	5.0	4.3	5.5	4.4	4.35	6.0
16	.....	4.3	5.8	4.6	4.95	4.55	5.1	4.6	4.35	5.95
17	4.4	4.3	5.4	4.7	4.85	4.45	4.95	4.5	4.35	5.85
18	4.6	4.3	5.0	4.6	4.8	4.6	5.25	4.45	4.45	.....
19	4.7	4.2	4.95	4.6	4.8	5.5	6.25	4.55	4.4	.....
20	4.9	5.6	4.9	4.7	4.8	4.5	5.3	4.45	4.4	.....
21	4.7	5.2	4.9	4.85	4.85	4.5	4.85	4.3	4.35	.....
22	4.7	5.15	4.8	5.0	4.85	4.85	4.65	4.4	4.3	.....
23	4.6	5.1	4.75	6.4	4.95	4.55	4.4	4.35	4.65	.....
24	4.4	5.05	4.65	6.5	5.15	4.6	4.3	4.2	4.55	.....
25	4.5	5.0	4.6	5.65	4.95	4.7	4.45	4.2	4.65	.....
26	4.5	4.95	4.9	5.2	7.95	4.55	4.1	4.2	4.5	.....
27	4.6	4.95	4.95	4.95	6.4	4.55	4.3	4.2	4.6	.....
28	4.4	4.95	5.1	6.9	5.4	4.4	4.25	4.25	4.5	.....
29	4.3	4.9	6.95	7.0	5.2	4.4	4.25	4.35	3.95	.....
30	4.2	4.7	6.1	6.05	4.95	4.4	4.25	4.25	5.45	.....
31	4.3	.....	5.75	.....	4.5	4.4	.....	4.25	.....	.....

NOTE.—Gage height estimated April 22-27, inclusive. River frozen November 30 to December 7, inclusive.

Daily discharge, in second-feet, of Loup River at Columbus, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	3,950	5,400	8,700	19,020	6,700	5,000	3,180	3,670
2	.....	4,400	5,150	7,500	15,120	19,190	4,700	3,910	3,450
3	.....	4,900	5,000	10,500	18,050	13,600	4,420	3,750	3,210
4	.....	6,950	5,400	7,500	17,080	8,270	4,380	3,580	3,210
5	.....	5,400	6,150	5,900	12,600	7,000	5,300	3,200	3,900
6	.....	4,400	6,675	5,650	11,700	5,300	5,770	3,250	5,100
7	.....	3,500	6,400	4,175	12,300	5,700	7,000	3,300	4,380
8	.....	3,050	5,900	3,725	9,900	6,110	6,960	3,350	4,110
9	.....	3,500	6,150	4,650	8,370	5,720	5,300	3,880	4,110
10	.....	3,950	11,100	4,175	6,750	5,600	5,010	3,940	4,380
11	.....	3,950	7,500	5,400	6,050	5,750	4,700	4,000	4,380
12	.....	3,500	6,950	5,400	5,400	5,600	4,410	4,070	4,600
13	.....	3,500	12,300	5,150	4,270	5,550	4,600	4,350	4,600
14	.....	3,950	15,780	4,650	2,900	5,250	7,110	4,600	4,850
15	.....	4,400	19,350	4,900	5,220	5,450	10,250	4,600	4,380
16	.....	3,950	12,300	5,400	5,100	6,700	8,400	5,600	4,380
17	4,400	3,950	9,900	5,900	4,730	6,110	6,950	5,100	4,380
18	5,400	3,950	7,500	5,400	4,650	6,850	8,580	4,850	4,850
19	5,900	3,500	7,225	5,400	4,800	12,100	14,600	5,330	4,600
20	6,950	11,100	6,950	5,900	4,920	6,200	8,710	4,850	4,600
21	5,900	8,700	6,950	6,675	5,310	6,150	6,130	4,110	4,380
22	5,900	8,400	6,400	7,500	5,460	8,000	5,050	4,600	4,110
23	5,400	8,100	6,150	16,100	6,130	6,300	3,810	4,380	5,850
24	4,400	7,800	5,650	16,750	7,400	6,500	3,310	3,670	5,350
25	4,900	7,500	5,400	11,400	6,430	7,000	3,950	3,670	5,850
26	4,900	7,225	6,950	8,700	25,800	6,110	2,400	3,670	5,100
27	5,400	7,225	7,225	7,225	15,450	6,050	3,150	3,670	5,600
28	4,400	7,225	8,100	19,350	9,450	5,230	3,000	3,900	5,100
29	3,950	6,950	19,680	20,000	8,430	5,170	3,050	4,380	2,600
30	3,500	5,900	14,150	13,820	7,320	5,100	3,120	3,900	2,600
31	3,950	.....	12,000	.....	4,970	5,050	.....	3,900	.....

NOTE.—The daily discharge was obtained from a rating table March 17 to July 10; and by the indirect method for the remainder of the year.

Estimated monthly discharge of Loup River at Columbus, Nebr., for 1905.

[Drainage area, 13,540 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 17-31	6,950	3,500	5,017	149,300	0.371	0.207
April	11,100	3,050	5,492	326,800	.406	.453
May	19,680	5,150	8,665	532,800	.640	.738
June	20,000	3,725	8,117	483,000	.599	.668
July	25,800	2,900	9,067	557,500	.670	.772
August	19,190	5,050	6,949	427,300	.513	.591
September	14,600	2,400	5,637	335,400	.416	.464
October	5,600	3,180	4,082	251,000	.301	.347
November	5,850	2,600	4,389	261,200	.324	.362
The period	.....	.....	.....	3,324,000	.....	.....

NOTE.—No estimate for ice period.

KANSAS RIVER DRAINAGE BASIN.

GENERAL FEATURES.

The drainage basin of Kansas river lies between the basins of the Platte and the Arkansas, entirely within the region of the Great Plains and extends through the arid, semiarid, and humid regions. It extends from Eastern Colorado to Missouri river, a distance of 485 miles.

The country presents throughout the same general appearance so far as contour of surface is concerned. It is a rolling prairie, through which the streams meander in winding courses in broad, fertile bottoms flanked on either side by bluffs. In the eastern part of Kansas the rivers are fringed with groves of timber; but to the west this becomes more and more scant, practically disappearing at the ninety-ninth meridian.

The principal tributaries are Smoky Hill and Republican rivers, whose union forms the main stream, and Blue River.

REPUBLICAN RIVER.

DESCRIPTION OF BASIN.

Republican River rises in the arid plains of Eastern Colorado, flows northeastward into southwestern Nebraska, then eastward through the southern tier of counties to Superior, where it turns to the southeast, enters Kansas, and about 2 miles northeast of Junction unites with Smoky Hill River to form Kansas River. The length of the basin east and west is approximately 360 miles, its greatest width is 120 miles, and the total area drained is 25,840 square miles. The river is wide and rather shallow, with a rapid descent, and the bed is largely shifting quicksand of the most unstable character.

In the upper portion of its course the Republican receives many tributaries, chiefly from the south. Nearly all of these flow through a region where the rainfall is less than 22 inches; but as this part of the basin is covered with buffalo grass, which sheds rain like a roof, the per cent of rainfall reaching the streams is great. Near the mouth the drainage area is very narrow, and the tributaries are small and unimportant; but here the rainfall is 28 to 38 inches. Many small springs occur along the main stream and its branches and the ground water lies generally at medium depth. There are no lakes or marshes of any considerable extent in the area.

The soil of the middle part of the basin is a porous, sandy loam and about 55 per cent of the land is under cultivation; along the lower course the soil is black loam and clay and about 75 per cent of the land is cultivated. The rainfall in the lower basin is considered sufficient for all growing crops and there are no irrigation works.

The Republican is subject to sudden rises and falls and occasionally overflows its banks. The most notable flood since 1895, when the gaging station at Junction was established, occurred in May and June, 1903. This covered all the low bottom lands and washed away fences, houses, crops, railway tracks, bridges, stock, and everything movable.

Information in regard to the basin is contained in the following Annual Reports of the United States Geological Survey: Eighteenth, Part IV, page 194; Twenty-first, Part IV, page 219.

REPUBLICAN RIVER NEAR BOSTWICK, NEBR.

This station was established June 6, 1904. It is located at a highway bridge 1 mile south of Bostwick, Nebr., in sec. 23, T. 1 N., R. 8 W., and replaces a station established at Superior, Nebr., in 1895.

The channel is straight both above and below the station. The left bank is high, but the right bank is low and subject to overflow at high stages. The bed of the stream is composed of shifting sands. The channel is somewhat obstructed by ice breakers and piers, but not seriously so. The current is never sluggish, even at low stages. Gage heights have a range of about 10 feet

Discharge measurements are made from the bridge, which has three 150-foot spans resting on tubular concrete piers. The initial point for soundings is the zero mark on the hand rail in line with the south face of the north downstream pier.

The gage was read during 1905 by M. A. McPherson, who lives one-fourth mile distant. It is of the standard chain type and the length of the chain is 20.52 feet. The gage is referred to bench marks as follows: (1) The top of the cast-iron bearing shoe at the north end of the downstream truss of the north span; the shoe rests on rollers on the top of the pier and has three openings, the east opening being the bench mark; elevation, 15.75 feet. (2) The northwest cardinal point of the rim or edge of the cover plate of the pier at the south end of truss described above; elevation, 15.89 feet. Elevations are above the zero of the gage.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 102–104.

Discharge measurements of Republican River near Bostwick, Nebr., in 1905.

Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 22	H. C. Gardner	430	639	1.85	2.45	1,181
April 29	do	930	830	2.40	3.00	2,009
June 7	do	420	585	1.78	2.55	1,045
July 6	do	440	3,188	4.66	8.30	14,870
July 26	do	430	1,806	3.27	5.45	5,915
August 10	do	410	1,141	2.70	3.55	3,082
September 30	F. S. Dobson	120	350	1.80	1.32	648

Daily gage height, in feet, of Republican River near Bostwick, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.15	2.75	3.3	6.25	6.35	1.2	1.25
2	.....	2.15	2.55	3.3	8.7	6.45	1.2	1.15
3	.....	2.2	2.5	4.1	9.3	6.9	1.9	1.15
4	.....	2.15	2.45	3.7	10.4	7.3	1.9	1.15
5	.....	2.15	2.45	2.9	9.5	5.65	1.9	1.1
6	.....	2.15	2.35	2.65	7.65	5.3	1.9	1.1
7	.....	2.5	2.35	2.55	5.5	5.5	1.5	1.1
8	.....	2.4	2.35	2.35	4.75	4.65	1.3	1.1
9	.....	2.35	2.4	2.25	4.5	4.05	1.3	1.05
10	.....	2.25	2.45	2.35	4.6	3.8	1.9	1.0
11	.....	2.2	6.1	2.4	4.1	3.5	1.3	1.0
12	.....	2.2	2.7	2.5	3.6	3.05	1.3	1.0
13	.....	2.1	3.0	4.0	3.35	2.8	1.1	.95
14	.....	2.1	3.05	3.0	3.05	2.5	1.1	.95
15	.....	2.1	3.15	2.7	2.9	2.35	1.1	.95
16	.....	2.05	5.4	4.15	2.85	2.5	1.2	1.0
17	.....	2.1	4.1	4.55	2.8	2.65	1.1	.95
18	.....	2.05	3.15	5.5	2.7	2.85	1.3	1.0
19	.....	2.05	2.95	3.85	2.65	2.55	1.2	1.0
20	.....	2.0	2.7	3.5	4.1	2.15	1.4	1.05
21	.....	2.25	2.5	3.0	2.5	2.0	1.45	1.05
22	2.45	2.05	2.45	2.85	2.4	1.85	1.4	1.05
23	2.5	2.2	2.35	5.2	2.35	1.75	1.35	1.1
24	2.45	2.45	2.45	5.75	2.25	1.7	1.45	1.1
25	2.4	2.6	2.35	6.05	2.15	1.65	1.6	1.1
26	2.4	2.95	2.25	5.85	5.7	1.65	1.55	1.1
27	2.4	2.8	2.45	5.5	3.65	1.6	1.55	1.1
28	2.3	3.1	2.25	4.15	3.5	1.5	1.5	1.1
29	2.3	3.0	5.4	3.85	5.4	1.3	1.4	1.1
30	2.25	2.9	3.9	4.15	4.65	1.3	1.35	1.1
31	2.2	.....	3.7	.....	4.9	1.3	.....	1.1

Station rating table for Republican River near Bostwick, Nebr., from June 6, 1904, to July 1, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	110	2.10	845	3.20	1,995	4.60	4,090
1.10	160	2.20	930	3.30	2,120	4.80	4,450
1.20	215	2.30	1,020	3.40	2,250	5.00	4,820
1.30	275	2.40	1,115	3.50	2,385	5.20	5,210
1.40	335	2.50	1,210	3.60	2,555	5.40	5,610
1.50	400	2.60	1,310	3.70	2,670	5.60	6,030
1.60	465	2.70	1,415	3.80	2,815	5.80	6,460
1.70	535	2.80	1,525	3.90	2,965	6.00	6,900
1.80	605	2.90	1,635	4.00	3,115	6.20	7,360
1.90	680	3.00	1,750	4.20	3,420		
2.00	760	3.10	1,870	4.40	3,750		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and three made in 1905, and is well defined between gage-heights 1.5 feet and 3.5 feet. Estimates based on the above and following tables are liable to considerable error, owing to the shifting character of the stream bed.

Station rating table for Republican River near Bostwick, Nebr., from July 2 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	440	2.60	1,750	4.20	3,850	6.60	8,860
1.10	500	2.70	1,860	4.30	4,010	6.80	9,460
1.20	560	2.80	1,970	4.40	4,170	7.00	10,080
1.30	630	2.90	2,080	4.50	4,340	7.20	10,720
1.40	700	3.00	2,200	4.60	4,510	7.40	11,400
1.50	770	3.10	2,320	4.70	4,680	7.60	12,120
1.60	850	3.20	2,440	4.80	4,860	7.80	12,880
1.70	930	3.30	2,570	4.90	5,040	8.00	13,640
1.80	1,010	3.40	2,700	5.00	5,220	8.20	14,400
1.90	1,090	3.50	2,830	5.20	5,600	8.40	15,200
2.00	1,180	3.60	2,970	5.40	6,000	8.60	16,000
2.10	1,270	3.70	3,110	5.60	6,410	8.80	16,850
2.20	1,360	3.80	3,250	5.80	6,840	9.00	17,750
2.30	1,450	3.90	3,390	6.00	7,300	9.20	18,650
2.40	1,550	4.00	3,540	6.20	7,780	9.40	19,550
2.50	1,650	4.10	3,690	6.40	8,300		

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905, and is poorly defined. See note to preceding table.

Estimated monthly discharge of Republican River near Bostwick, Nebr., for 1905.

[Drainage area, 23,270 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 22-31	1,210	930	1,082	21,460	0.046	0.017
April	1,870	760	1,060	63,070	.046	.051
May	7,130	975	1,927	118,500	.083	.096
June	7,015	975	2,949	175,500	.127	.142
July	24,500	1,315	5,734	352,600	.246	.284
August	11,060	630	3,082	189,500	.132	.152
September	1,090	500	725	43,140	.031	.035
October	595	410	479	29,450	.021	.024
The period				993,200		

REPUBLICAN RIVER AT BENKELMAN, NEBR.

This station was established November 1, 1894, discontinued September 7, 1895, and reestablished May 20, 1903, at a point some distance below the original location. It is located about one-half mile east of Benkelman, Nebr., on the line between secs. 17 and 20, T. 1 N., R. 37 W.

The river is nearly straight both above and below the station. The banks are low, but seldom overflow. The bed is composed of shifting sand. The channel is slightly obstructed by the piling of the bridge, on which considerable débris lodges at times of high water. The current is never sluggish, even at low stages. Gage heights have a range of about 4 feet. It is impossible to obtain records of winter flow.

Discharge measurements are made from the upstream side of the highway bridge. The initial point for soundings is the zero mark on the upstream hand rail at the east end of the bridge.

The gage, which was read during 1905 by Leon L. Hines, is a vertical staff 6 feet long spiked to the downstream side of the second bent from the west end of the bridge. The gage is referred to five bench marks, as follows: (1) The top of the south end of the concrete foundation for the west upright bent of the elevated track in the Burlington and Missouri River Railroad yards; elevation, 16.14 feet. Nos. 2, 3, 4, and 5 are, respectively, the tops of the south ends of the first, second, third, and fourth bents from the west end of the bridge; elevations, respectively, 6.88, 6.74, 6.34, and 6.19 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 131, p 33; 140, pp 125-127; WS 99, pp 220-221; 131, p 95.
Discharge: Ann 18, iv, p 206; 20, iv, p 302; Bull 131, pp 33, 92; 140, p 126; WS 50, p 311; 84, p 113; 99, p 221; 131, p 95.
Discharge, mean daily: WS 131, p 97
Discharge, monthly: WS 99, p 222; 131, p 98.
Gage heights: Bull 140, p 129; WS 99, p 221; 131, p 96.
Rating table: Bull 140, p 128; WS 99, p 222.

Discharge measurements of Republican River at Benkelman, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 21	H. C. Gardner	160	61	1.16	1.20	171
May 2	do	230	69	2.26	1.35	156
June 6	do	45	34	1.79	1.25	61
July 5	do	65	24	1.50	1.10	36
July 31	G. W. Bates		70	2.29	1.40	160
August 28	H. C. Gardner	2[illegible]	6.7	1.60	.80	10
September 28	F. S. Dobson	130	35	1.40	1.10	49

Daily gage height, in feet, of Republican River at Benkelman, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		1.45	1.3	1.4	1.3	1.2	0.8	1.2
2		1.5	1.25	1.35	1.4	1.1		1.2
3		1.35	1.3	1.25	1.25	1.2	.8	1.2
4		1.2	1.3	1.2	1.15	1.15		1.2
5		1.3	1.3	1.25	1.1	1.05		1.2
6		1.25	1.3	1.2	1.1	1.2	1.05	1.2
7		1.25	1.3	1.15	1.1	1.1	1.1	1.2
8		1.3	1.4	1.1	1.18	1.05	1.05	1.15
9		1.3	1.4	1.15	1.25	1.05	1.3	1.1
10		1.35	1.4	1.3	1.25	1.05	1.3	1.2
11		1.3	1.3	1.4	1.25	1.15	1.2	1.2
12		1.3	1.3	1.35	1.1	1.25	1.1	1.2
13		1.3	1.3	1.35	1.1	1.15	1.2	1.2
14		1.3	1.25	1.2	1.05	1.05	1.2	1.2
15		1.3	1.25	1.2	1.0	1.05	1.1	1.3
16		1.3	1.25	1.25	1.0	1.05	1.2	1.2
17		1.25	1.25	1.45	1.1	1.0	1.1	1.2
18		1.25	1.3	1.35	1.05	1.0	1.2	1.2
19	1.4	1.25	1.4	1.25	1.0	.95	1.3	1.2
20	1.35	1.3	1.3	1.2	1.1	.95	1.3	1.2
21	1.2	1.35	1.35	1.2	1.15	.95	1.2	1.25
22	1.0	1.3	1.3	1.4	1.2	.95	1.2	1.3
23	1.1	1.52	1.3	1.2	1.15	.8	1.2	1.25
24	1.1	1.75	1.45	1.2	1.15	.8	1.1	1.25
25	1.05	1.5	1.45	1.15	1.1	.8	1.2	1.25
26	1.15	1.4	1.4	1.2	1.1	.85	1.2	1.25
27	1.2	1.3	1.4	1.2	1.1	.95	1.2	1.3
28	1.2	1.35	1.4	1.15	1.35	.8	1.2	1.35
29	1.1	1.4	1.6	1.15	1.35	.8	1.1	1.45
30	1.0	1.35	1.5	1.15	1.8	.78	1.1	1.55
31	1.25		1.4		1.3	.75		1.6

SOUTH FORK OF REPUBLICAN RIVER AT BENKELMAN, NEBR.

This station was established November 1, 1894, discontinued September 5, 1895, and reestablished May 20, 1903. It is located at the highway bridge about three-fourths of a mile east of Benkelman, on the line between secs. 17 and 20, T. 1 N., R. 37 W., and is about one-fourth mile above the mouth of the South Fork.

The channel is straight both above and below the station. The banks are low, but seldom overflow. The bed is composed of shifting sand. The piling of the bridge obstructs the

channel to a limited extent. The current is never sluggish, even at low stages. Gage heights have a range of about 4 feet.

Discharge measurements are made from the upstream side of the highway bridge. The initial point for soundings is the zero mark on the upstream hand rail at the east end of the bridge.

The gage, which was read during 1905 by Leon L. Hines, is a vertical staff 5.5 feet long spiked to the upstream side of the first bent in the channel from the east bank of the stream. It is referred to five bench marks, as follows: (1) The top of the south end of the concrete foundation for the first upright bent of the elevated track in the Burlington and Missouri River Railroad yards; elevation, 18.29 feet. Nos. 2, 3, 4, and 5 are, respectively, the tops of the south ends of the first, second, third, and fourth bents from the west end of the bridge; elevations, respectively, 6.62, 6.48, 6.38, and 6.20 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 131, p 33; 140, p 130; WS 99, pp 222-223; 131, pp 98-99.
Discharge: Ann 18, iv, p 206; Bull 140, p 130; WS 50, p 311; 84, p 113; 99, p 223; 131, p 99.
Discharge, mean daily: WS 131, p 101.
Discharge, monthly: WS 99, p 224; 131, p 102.
Gage heights: Bull 140, pp 130-131; WS 99, pp 223-224; 131, p 100.
Rating table: WS 99, p 224.

Discharge measurements of South Fork of Republican River at Benkelman, Nebr., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 21	H. C. Gardner	108	77	1.82	1.77	140
May 2	do	210	73	1.52	1.65	111
June 6	do	60	25	1.36	1.30	34
July 5	do	100	29	1.91	1.40	51
July 31	G. W. Bates	85	44	1.63	1.45	72
August 28	H. C. Gardner					0
September 28	F. S. Dobson	75	16	1.28	1.20	21

Daily gage height, in feet, of South Fork of Republican River at Benkelman, Nebr., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		1.85	1.7	1.65	1.6	1.6		
2		1.9	1.65	1.55	1.55	1.5		
3		2.05	1.65	1.5	1.6	1.5		
4		1.95	1.7	1.45	1.5	1.5		
5		1.9	1.7	1.35	1.4	1.4	1.35	
6		1.8	1.6	1.35	1.4	1.35		
7		1.75	1.6	1.3	1.4	1.3		
8		1.75	1.6	1.25	1.35	1.25		
9		1.75	1.65	1.35	1.35	1.25		
10		1.75	1.7	1.85	1.25	1.2	1.45	
11		1.75	1.7	1.6	1.2	1.25		
12		1.55	1.7	1.55	1.2	1.25		
13		1.5	1.5	1.35	1.15	1.3		
14		1.4	1.55	1.35	1.1	([a])		
15		1.4	1.55	1.3	1.0			
16		1.4	1.55	13.5	1.1			
17	2.1	1.5	1.5	2.2	1.0			
18	1.95	1.45	1.45	1.7	1.1	1.55		
19	2.1	1.45	1.6	1.6	1.0		1.5	
20	1.95	1.55	1.7	1.55	1.0		1.5	
21	1.85	1.6	1.4	1.2	1.1			
22	1.8	1.5	1.75	1.55	1.15			
23	1.8	1.8	1.45	1.45	1.1			
24	1.8	2.1	1.45	1.45	1.1			
25	1.75	2.25	1.45	1.35	1.1			1.35
26	1.7	2.05	1.65	1.35	1.1			1.35
27	1.6	2.05	1.65	1.35	1.05			1.4
28	1.7	2.0	1.6	1.25	1.1			1.45
29	1.7	1.8	1.75	1.25	1.2			1.5
30	1.7	1.75	1.65	1.25	1.8			1.55
31	1.78		1.75		1.7			1.6

[a] Channel obstructed by sand August 14 to October 31.

Station rating table for South Fork of Republican River at Benkelman, Nebr., from March 17 to August 13, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	5	1.40	52	1.70	123	2.00	215
1.10	10	1.50	73	1.80	152	2.10	249
1.20	21	1.60	96	1.90	183	2.20	283
1.30	35						

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. Estimates based on this table are liable to considerable error owing to the shifting character of the stream beds.

Estimated monthly discharge of South Fork of Republican River at Benkelman, Nebr., for 1905.

[Drainage area, 5,910 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 17-31	249	96	159	4,730	0.027	0.015
April	300	52	141	8,390	.024	.027
May	137	52	100	6,149	.017	.020
June	283	21	68.6	4,082	.012	.013
July	152	5	35.4	2,177	.006	.0069
August 1-13	96	21	47.7	1,230	.0081	.0039
The period				26,760		

REPUBLICAN RIVER AT JUNCTION, KANS.

This station was established April 26, 1895. It is located at the wagon bridge at the north end of Washington street, Junction, about 2 miles above the mouth of the river.

The channel is straight for about 300 feet both above and below the station and is broken by three piers. The right bank is high, but the left is low and may overflow at high water. The bed of the stream is sandy and liable to change. The flow is moderately rapid. The flood of 1903 cut a new channel, about 220 feet wide, north of the wagon bridge, and for a time this carried most of the water. This channel was at first bridged by a pile bridge, but later it was filled, so that now all the water flows in the old channel. The slope of the river at the gage October 3, 1905, was 0.0024544 foot per foot for a distance of 658 feet.

Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is at the south end of the bridge.

The gage, which was read during 1905 by J. H. Rathert, is in two sections. The first section is an inclined timber, graduated from zero to 11 feet, spiked to a pile and to a large cottonwood tree; the second section is graduated from 11 to 25 feet, and spiked in an upright position to a large cottonwood tree. The gage is referred to bench marks as follows: (1) A spike driven into the west side of an 18-inch cottonwood tree standing 10 feet west of the bridge on the right bank of the river; the spike is about 2 feet above the ground and has an elevation of 12.36 feet above the zero of the gage. (2) The top of a stone, marked with a cross and the letters "B. M.," at the base of the abutment south of No. 3; elevation, 14.28 feet above the zero of the gage.

This station was discontinued October 31, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 203; Bull 140, pp 136-137; WS 16, p 109; 27, p 90; 37, p 248; 50, p 313; 66, p 43; 84, p 100; 99, p 214; 131, p 105.

Discharge: Ann 18, iv, p 204; Bull 140, p 137; WS 16, p 109; 27' p 95; 37, p 248; 50, p 313; 66, p 43; 84, p 100; 99, p 214; 131, p 105.

Discharge, monthly: Ann 18, iv, p 205; 19, iv, p 340; 20, iv, pp 312, 318; 21, iv, p 221; 22, iv, p 333; Bull 140, p 138; WS 75, p 141; 84, p 102; 99, p 216; 131, p 108.

Discharge, yearly: Ann 20, iv, p 55.

Gage heights: Bull 140, p 137; WS 11, p 57; 16, p 109; 27, p 92; 37, p 249; 50, p 314; 66, p 43; 84, p 101; 99, p 215; 131, p 106.

Hydrographs: Ann 18, iv, p 204; 19, iv, p 340; 20, iv, p 318; 21, iv, p 221; 22, iv, p 333; WS 75, p 141.

Rainfall and run-off relation: Ann 20, iv, p 313.

Rating tables: Ann 18, iv, p 205; 19, iv, p 339; WS 27, p 96; 39, p 449; 52, p 517; 66, p 171; 84, p 101; 99 p 215; 131, p 107.

Discharge measurements of Republican River at Junction, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 28	W. G. Russell	163	410	3.33	4.20	1,368
April 11	do	163	389	2.97	4.10	1,156
May 23	do	186	557	3.98	4.70	2,219
June 26	do	248	1,964	4.57	8.70	8,973
June 27	do	246	1,887	4.46	8.45	8,421
July 22	do	313	1,051	3.46	5.70	3,641
August 15	do	248	858	3.43	5.30	2,941
October 4	do	248	446	2.17	3.65	969

Daily gage height, in feet, of Republican River at Junction, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.9	4.1	7.42	4.0	4.65	7.98	7.4	8.28	4.0	3.8
2	3.9	4.1	6.1	4.0	4.95	6.75	9.3	7.55	3.98	3.8
3	3.9	4.1	5.95	4.0	4.88	5.5	10.65	7.45	3.9	3.8
4	4.05	4.1	5.65	4.0	4.68	5.7	11.0	7.85	3.9	3.7
5	4.1	3.9	5.48	3.95	4.58	6.5	11.1	7.88	3.92	3.6
6	4.1	3.8	5.48	3.95	4.4	6.12	11.2	8.55	4.1	3.6
7	4.1	3.7	5.12	3.95	4.4	5.9	12.55	8.58	4.1	3.58
8	4.02	3.5	4.78	3.92	4.4	5.18	15.3	7.45	4.28	3.52
9	3.88	3.2	4.68	3.9	6.3	4.85	12.25	6.95	4.35	3.5
10	3.85	3.2	4.5	3.9	5.45	4.65	7.65	6.4	4.35	3.5
11	3.85	3.2	4.42	4.02	4.42	4.6	7.2	5.9	4.15	3.5
12	3.85	3.2	4.3	4.15	4.4	4.6	6.5	5.65	4.05	3.5
13	3.85	3.15	4.3	4.08	5.35	4.35	6.3	5.5	4.0	3.5
14	3.85	3.15	4.22	4.08	7.15	4.08	6.0	5.4	4.15	3.45
15	3.85	3.15	4.15	3.9	5.45	4.15	5.6	5.28	4.02	3.4
16	3.85	3.15	4.25	3.85	4.8	4.9	5.4	5.5	4.0	3.4
17	3.85	3.15	4.28	3.8	4.9	5.6	4.8	5.2	3.9	3.4
18	3.85	3.15	4.3	3.8	5.45	5.05	5.02	5.05	3.9	3.35
19	3.85	3.15	4.3	3.75	7.35	5.1	4.7	4.9	3.82	3.4
20	3.92	3.15	4.3	3.7	6.1	6.85	4.65	4.88	3.8	3.4
21	3.98	4.75	4.32	3.7	5.35	7.55	4.6	5.05	3.75	3.4
22	4.08	5.9	4.38	3.78	5.02	6.35	5.3	5.0	3.72	3.4
23	4.1	6.2	4.4	3.8	4.72	5.95	6.35	4.6	3.68	3.4
24	4.1	5.85	4.25	3.9	4.55	8.55	5.68	4.5	3.75	3.4
25	4.1	5.45	4.38	4.62	9.0	8.1	4.8	4.4	3.8	3.4
26	4.1	5.22	4.35	4.45	7.7	8.7	5.15	4.4	3.65	3.4
27	4.1	7.05	4.32	4.5	6.1	8.35	5	4.4	3.65	3.4
28	4.1	7.2	4.28	5.25	5.52	8.3	9.0	4.3	3.65	3.4
29	4.1	.....	4.2	5.22	5.35	11.15	8.65	4.28	3.8	3.4
30	4.1	.....	4.0	4.95	6.4	9.3	8.48	4.15	3.85	3.45
31	4.1	.....	4.0	.....	9.0	.....	7.7	4.08	.....	3.5

Station rating table for Republican River at Junction, Kans., from January 1 to May 13, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	250	4.20	1,320	5.30	2,950	6.40	4,730
3.20	310	4.30	1,460	5.40	3,100	6.50	4,905
3.30	380	4.40	1,600	5.50	3,250	6.60	5,085
3.40	460	4.50	1,750	5.60	3,400	6.70	5,265
3.50	550	4.60	1,900	5.70	3,560	6.80	5,450
3.60	650	4.70	2,050	5.80	3,720	6.90	5,640
3.70	750	4.80	2,200	5.90	3,880	7.00	5,830
3.80	850	4.90	2,350	6.00	4,050	7.20	6,230
3.90	960	5.00	2,500	6.10	4,220	7.40	6,650
4.00	1,080	5.10	2,650	6.20	4,390		
4.10	1,200	5.20	2,800	6.30	4,560		

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during the first part of 1905, and is fairly well defined.

Station rating table for Republican River at Junction, Kans., from May 14 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	600	4.70	2,210	6.40	4,730	9.40	11,660
3.30	680	4.80	2,340	6.60	5,085	9.60	12,230
3.40	760	4.90	2,470	6.80	5,450	9.80	12,830
3.50	850	5.00	2,600	7.00	5,830	10.00	13,450
3.60	950	5.10	2,735	7.20	6,230	10.50	15,020
3.70	1,050	5.20	2,870	7.40	6,650	11.00	16,700
3.80	1,150	5.30	3,010	7.60	7,080	11.50	18,450
3.90	1,250	5.40	3,150	7.80	7,525	12.00	20,200
4.00	1,360	5.50	3,295	8.00	7,995	12.50	22,200
4.10	1,470	5.60	3,440	8.20	8,480	13.00	24,200
4.20	1,580	5.70	3,590	8.40	8,980	14.00	28,700
4.30	1,700	5.80	3,745	8.60	9,490	15.00	33.700
4.40	1,820	5.90	3,900	8.80	10,010		
4.50	1,950	6.00	4,060	9.00	10,550		
4.60	2,080	6.20	4,390	9.20	11,100		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905 and five during 1904, and is fairly well defined. The table has been extended beyond these limits.

Estimated monthly discharge of Republican River at Junction, Kans., for 1905.

[Drainage area, 25,840 square miles.]

Month.	Discharge in second-feet.			Run-off.		
	Maximum.	Minimum.	Mean.	Total in acre-feet.	Second-feet per square mile.	Depth in inches.
January	1,200	905	1,056	64,930	0.041	0.047
February	6,230	280	1,562	86,750	.060	.062
March	6,692	1,080	2,043	125,600	.079	.091
April	2,875	750	1,233	73,370	.048	.054
May	10,550	1,600	3,589	220,700	.139	.160
June	17,220	1,448	5,184	308,500	.201	.224
July	35,350	2,080	8,559	526,300	.331	.382
August	9,439	1,448	4,048	248,900	.157	.181
September	1,760	1,000	1,293	76,940	.050	.056
October	1,150	720	847	52,080	.033	.038
The period				1,784,000		

NOTE.—Ice conditions uncertain; discharge applied as for open channel.

MISCELLANEOUS MEASUREMENT.

July 18, 1905, a measurement of the North Fork of Republican River at Benkelman, Nebr., gave the following results: Area of section, 70 square feet; mean velocity, 2.29 feet per second; discharge, 160 second-feet.

SMOKY HILL RIVER.

DESCRIPTION OF BASIN.

Smoky Hill River rises near the boundary between Kansas and Colorado, pursues a winding, but on the whole easterly, course through Kansas, and near Junction unites with Republican River to form Kansas River. Its length is 335 miles and the extreme width of its basin is about 100 miles. The river runs close to the northern border of the Arkansas basin, and its chief tributaries are from the north. Solomon and Saline rivers are the most important, the former draining the northern part of Kansas and the latter the territory between the Solomon and the Smoky Hill.

The headwater region is a rolling, upland prairie, sparsely timbered along the streams with cottonwood, box elder, hackberry, elm, and willow trees. To the east the stream is bordered by bluffs rising from 100 to 250 feet above the bottoms. The middle portion of the basin is an undulating prairie, well adapted to stock raising and farming. The eastern section is a rich agricultural country, the soil being a black, sandy loam, which produces large and varied crops. There are no lakes or marshes in the area.

The precipitation varies from about 12 inches, in the extreme western part of the basin, to 30 inches in the eastern part. Nearly all of this is rain which falls during the growing season. The snowfall is generally light, is very dry, and never causes any high water. There is an abundant supply of underground water in the western part of the area, but as a rule it is deep. In other sections the supply is good. Numerous springs occur along the banks of the river and its tributaries. There are several good dam sites in the basin, but the flood water carries so much sand and silt that any reservoir would soon fill up.

Floods seldom occur in the upper and middle sections of the river, but in the lower part they are more frequent. The most notable flood in the upper river was that in July, 1895, but this did little damage farther down. The great floods in the lower river occurred in, 1903 and 1904. The 1903 flood did much damage.

Information in regard to the basin is contained in United States Geological Survey publications as follows: Eighteenth Annual Report, Part IV, page 207; Twenty-first Annual Report, Part IV, page 223; Bulletin No. 140, page 138.

SMOKY HILL RIVER AT ELLSWORTH, KANS.

This station was established April 16, 1895. It is located at the highway bridge on Douglass avenue, Ellsworth, Kans.

The channel is straight above and below the station at high water, but at other times is slightly curved. Both banks are low, wooded, and subject to overflow. The bed of the stream is composed of sand and is free from vegetation and shifting. The current is medium at low and swift at high stages. The slope of the stream above the gage is 1.44 feet in 2,536 feet, or 0.000568 foot per foot.

Discharge measurements are made from the downstream side of the bridge, which is 293 feet long between abutments and consists of three spans. The initial point for soundings is at the noth end of the bridge, downstream side.

The gage, which was read during 1905 by Thomas Coyne, is in two sections. The first section is an inclined timber, graduated from zero to 4 feet, securely fastened to the iron pier of the bridge and to posts driven into the bed of the river. The second section is graduated from 3.7 to 21 feet, and spiked to the same pier. The gage is referred to bench marks as follows: (1) A nail driven into the base of a box elder tree near the southeast corner of the bridge, 90 feet from the gage; elevation above the zero of the gage, 13.07 feet. (2) The top of a nail driven into the root on the north side of an elm tree 2 feet in diameter about 45 feet west of bench mark No. 1; elevation about 11.34 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey. (Ann.=Annual Report; Bull.=Bulletin. WS.=Water-Supply Paper):

Description: Ann 18, iv, pp 212-213; Bull 140, p 142; WS 16, p 114; 27, p 90; 37, p 251; 50, p 316; 66, p 45; 84, p 110; 99, p 230; 131, pp 108-109.

Discharge: Ann 18, iv, p 213; Bull 140, p 143; WS 16, p 114; 27, p 95; 37, p 251; 50, p 316, 66, p 45; 84 p 110; 99, p 231; 131, p 109.

Discharge, monthly: Ann 18, iv, p 214; 19, iv, p 347; 20, iv, p 315; 21, iv, p 225; 22, iv, p 336; Bull 140, p 143; WS 75, p 143; 84, p 112; 99, p 232; 131, p 111.

Discharge, yearly: Ann 20, iv, p 56.

Gage heights: Bull 140, p 143; WS 11, p 58; 16, p 114; 27, p 93; 37, p 252; 50, p 317; 66, p 45; 84, p 111; 99, p 231; 131, p 109.

Hydrographs: Ann 18, iv, p 215; 19, iv, p 347; 20, iv, p 315; 21, iv, p 226; 22, iv, p 336.

Rating tables: Ann 18, iv, p 214; 19, iv, p 346; WS 27, p 96; 39, p 449; 52, p 317; 66, p 172; 84, p 111; 99, p 232; 131, p 110.

Discharge measurements of Smoky Hill River at Ellsworth, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 21	W. G. Russell	57	80	2.04	1.55	163
August 14	do	150	206	1.73	2.25	356

Daily gage height, in feet, of Smoky Hill River at Ellsworth, Kans., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1.8	0.9	1.4	4.0	9.15	2.8	0.9	0.9
2	.....	1.6	.9	1.3	3.2	6.4	3.6	.9	.9
3	.....	1.5	.95	1.3	2.8	6.0	3.2	.9	.85
4	.....	1.5	.9	1.2	3.0	5.0	2.6	.9	.85
5	.....	1.4	.9	1.15	2.6	5.8	2.25	.95	.85
6	.....	1.4	.9	1.1	2.3	4.3	2.2	1.3	.85
7	.....	1.3	.85	1.05	2.1	4.6	2.1	1.1	.85
8	.....	1.25	.85	1.0	2.0	3.4	1.9	1.0	.85
9	.....	1.2	.85	8.5	1.8	3.0	1.8	1.0	.85
10	.....	1.2	.85	2.7	1.7	2.7	1.7	1.0	.85
11	.....	1.2	.85	1.8	1.65	2.6	1.6	1.0	.8
12	.....	1.15	.8	1.6	1.6	2.4	1.5	.95	.8
13	.....	1.15	.8	1.5	1.55	2.3	6.0	.95	.8
14	.....	1.1	.8	1 35	1.5	3.2	4.3	.95	.8
15	.....	1.1	.85	1.3	1.4	2.4	3.6	1.0	.75
16	.....	1.05	.85	1.3	2.2	2.1	3.4	1.0	.75
17	.....	1.05	.8	1.25	1.7	1.9	2.6	1.0	.75
18	.....	1.15	.8	1.2	1.7	1.7	2.0	1.0	.75
19	1.7	1.15	.85	1.25	1.65	1.6	1.7	.95	.75
20	1.7	1.1	.9	1.2	1.8	1.5	1.6	.95	.75
21	3.3	1.1	.9	1.2	1.6	1.55	1.55	.95	.75
22	3.4	1.1	.9	1.2	1.5	1.65	1.5	.9	.7
23	2.1	1.05	.85	1.2	1.4	1.9	1.5	.9	.7
24	1.9	1.05	.9	1.4	1.9	1.85	1.4	.95	.7
25	1.7	1.05	.95	2.5	1.7	1.6	1.35	.95	.9
26	1.8	1.0	.95	1.8	1.5	1.6	1.2	.95	.9
27	1.85	1.0	.95	1.6	1.45	1.5	1.1	.95	.85
28	1.8	.95	1.0	5.5	1.4	1.4	1.1	.95	.85
29	.....	.95	1.5	4.4	1.8	1.6	1.05	.9	.85
30	.....	.95	1.45	3.6	8.4	1.7	1.05	.9	.85
31	.....	.9	.....	3.1	.....	1.7	1.0	.....	.85

NOTE.—River frozen January 1 to February 18.

BEAVER RIVER (LADDER CREEK) NEAR SCOTT CITY, KANS.

Beaver River rises in eastern Colorado and flows southeastward, eastward, and then northward to its junction with Smoky Hill River. Its basin, which lies entirely within the Great Plains and chiefly in the arid belt, has a length, east and west, of about 90 miles and an extreme width of not over 25 miles, the total area, measured at the mouth, being 1,464 square miles. The stream has no mountain tributaries but depends for its supply on the precipitation, which ranges from an annual average of about 12 inches at the source to 18 inches near the mouth. There is very little timber in the basin and that is of poor quality. Throughout its middle and lower course the stream flows in a narrow valley between hills 150 to 200 feet high, affording sites for dams and reservoirs; but the dams would be long and expensive and the supply of water from the basin would be insufficient. The tributaries are few and small and furnish little water except in the wet season. Along the lower course of the creek there are very fine springs which furnish water for a small amount of irrigation.

The gaging station was established May 18, 1904. It is located about 18 miles north of Scott City, Kans., at the Hatheway ranch, about 250 yards southwest of H. H. Hatheway's residence.

At low water the channel is very crooked, but after the water covers the bottom the channel is straight for about 100 feet above and below the station. The right bank is high and

wooded and does not overflow; the left bank is low and wooded and overflows at high water. The bed of the stream is composed of mud and is covered with vegetation and permanent. There is but one channel at all stages. A heavy growth of willows and other small brush along the channel prevents very accurate measurements.

Discharge measurements are made at low water by wading; at high water the flow must be computed from the cross section and slope, both of which were taken at the time the gage was established. The initial point for soundings is at the right bank.

The gage, which was read daily by James H. Drain, is a staff, spiked in a perpendicular position to a willow tree on the left bank. The bench mark is the top of a nail driven into the root of a willow tree about 8 inches in diameter, located on the right bank of the creek about 20 feet northeast of the gage; it is near the surface of the ground and has an elevation of 3.04 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 131 of the United States Geological Survey, pages 112–113.

A discharge measurement of this creek, made May 18, 1905, by W. G. Russell, gave the following results: Width, 6 feet; area of section, 5.4 square feet; mean velocity, 1.69 feet per second; gage height, 1.30 feet; discharge, 9.1 second-feet.

Daily gage height, in feet, of Beaver River (Ladder Creek) near Scott City, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.7	1.7	1.8	1.75	3.0	3.0	4.8	8.0	1.5	1.5	1.5
2	1.7	1.7	1.8	1.6	2.9	2.0	6.0	3.0	1.5	1.5	1.5
3	1.7	1.8	1.9	1.6	2.9	1.5	5.5	2.5	1.5	1.5	2.0
4	1.7	1.8	2.0	1.7	2.8	1.0	4.5	2.5	1.5	1.5	2.0
5	1.7	2.0	1.6	1.7	2.75	1.0	4.0	2.0	2.0	1.5	2.0
6	1.7	2.0	1.6	1.7	2.65	1.0	3.0	1.5	2.5	1.5	1.5
7	1.7	2.0	1.6	1.7	2.0	1.0	2.0	1.5	6.0	1.5	1.5
8	1.8	2.0	1.6	1.7	2.0	1.0	2.0	1.5	5.5	1.5	1.5
9	1.8	2.0	1.7	1.8	2.0	1.0	1.5	1.5	2.5	1.5	1.5
10	1.8	2.0	1.7	1.8	1.95	1.0	1.5	1.5	2.5	1.5	1.5
11	1.8	2.0	1.7	1.9	1.8	4.0	1.5	1.5	2.5	1.5	2.0
12	1.8	2.0	2.0	1.9	1.75	3.0	1.5	2.0	2.5	1.5	2.0
13	1.9	2.0	2.0	1.9	1.6	2.5	1.5	1.5	2.5	1.5	1.5
14	2.0	2.0	2.0	1.9	1.3	2.0	1.5	1.5	2.5	1.5	1.5
15	2.0	2.0	2.0	1.9	1.3	1.5	1.5	1.5	2.0	1.5	1.5
16	1.1	2.1	2.0	1.95	1.3	1.5	1.5	1.5	2.0	1.5	1.5
17	1.1	2.1	2.0	1.95	1.3	1.5	1.5	1.5	2.5	1.5	1.5
18	1.1	2.1	2.0	1.95	1.3	1.5	1.5	1.5	2.5	1.5	1.5
19	1.9	2.2	1.9	1.95	1.3	1.5	1.5	1.5	2.5	1.5	1.5
20	1.9	2.2	1.9	2.0	1.3	4.0	1.5	1.5	2.5	1.5	1.5
21	1.8	2.2	1.9	2.0	1.3	3.0	1.5	1.5	1.5	1.5	1.5
22	1.8	2.2	1.85	2.0	1.3	1.5	1.5	1.5	1.5	1.5	1.5
23	1.8	2.2	1.8	2.0	1.3	1.5	1.5	1.5	1.5	1.5	1.5
24	1.7	2.2	1.8	2.0	6.0	1.5	3.5	1.5	1.5	1.5	1.5
25	1.7	2.2	1.8	2.3	4.0	1.5	2.0	1.5	1.5	1.5	1.5
26	1.7	1.6	1.8	2.3	3.0	1.5	2.0	1.5	1.5	1.5	1.5
27	1.7	1.6	1.8	2.5	2.5	1.5	1.5	1.5	2.0	1.5	1.5
28	1.7	1.6	1.8	2.6	6.5	1.5	3.5	1.5	2.0	1.5	1.5
29	1.7	.....	1.75	2.9	6.5	1.5	2.5	1.5	2.0	1.5	1.5
30	1.7	.....	1.75	3.0	5.0	5.0	4.5	1.5	2.0	1.5	1.5
31	1.7	.....	1.75	.....	4.3	.....	3.0	1.5	.....	1.5	.....

KANSAS RIVER.

DESCRIPTION OF BASIN.

Kansas River as such is a comparatively short stream, being formed by the union of Smoky Hill and Republican rivers in Geary County, Kans., whence it flows eastward, entering the Missouri at Kansas City, Mo.

The immediate basin, which comprises the richest portion of the State of Kansas, consists of bottoms and rolling uplands, well timbered with oak, cottonwood, ash, elm, hickory, etc. The section is under a high state of cultivation and produces a great variety of crops.

The river flows through a rich alluvial bottom land. The banks are sandy and easily cave in. In places the bed contains rock and bowlders, but in general it is composed of sand and at many points of quicksand. The channel as a rule hugs one bank or the other and is somewhat shifting. Islands are formed here and there by the deposit of sediment during high water, drift lodges upon them, and a thick growth of brush, mainly cottonwood, soon springs up. At Topeka the river is 900 feet wide between banks. At ordinary low water the channel occupies 150 to 200 feet of this width and has a depth of 8 to 9 feet; at mean high water the average depth of the water is probably 10 feet for the entire distance between banks.

The most important feeder of the Kansas below the junction of Smoky Hill and Republican rivers is the Blue, which rises in southeastern Nebraska, flows to the southeast and south into Kansas, and joins Kansas River at Manhattan. The principal tributary of the Blue is the Little Blue, which rises in southern Nebraska, flows southeastward, and unites with the main stream near Blue Rapids. The Blue runs through a bottom land 1½ miles wide, bordered by bluffs 300 feet high. The banks are of loam and range in height from 10 to 30 feet. The bed is sandy and gravelly, with many limestone ledges. In its lower course the river is about 250 feet wide, and at medium low water has a depth of perhaps 4 feet and a moderate current. The soil of the basin is chiefly a sandy loam with some clay and is generally porous; the region is in a high state of cultivation.

Both the Kansas and the Blue have periods of high water nearly every year, but disastrous floods are rare. The most notable flood on record is that which occurred in May and June, 1903, when the water covered all the low bottom lands, destroying many lives and millions of dollars worth of property.

There are no irrigation projects in the basin, as it is claimed that the rainfall is ample and timely. Good natural dam sites are lacking.

Information in regard to the basin is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Altitudes in: Bull 140, p 124.

Description: Ann 18, iv, p 194; 18, iv, p 215; 19, iv, pp, 337-338; 20 iv, pp 304-305; 21, iv, p 228; 22, iv, p 331; Bull 131, pp 32-33; 140, pp 123-125; WS 75, p 140; 84, p 95; 99, p 208; 131, pp 87-88.

Drainage areas: Bull 140, p 124.

Rainfall and river stations, map: Ann 20, iv, p 305.

Rainfall and run-off relation: Ann 20, iv, p 313.

Rainfall data: Ann 20, iv, pp 305-313.

See also WS 74.

KANSAS RIVER AT LECOMPTON, KANS.

This station was established April 16, 1899. It is located at the new wagon bridge at Lecompton, Kans.

The channel is somewhat curved at the bridge and has a width of 800 feet, broken by four metal piers. The bridge is slightly oblique to the direction of the current. The left bank is low and subject to overflow during high water. The bed of the stream is composed of sand, with some rock, and changes slightly.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is at the first set of piers at the south end of the bridge.

The gage was read during 1905 by A. D. McAdow. The original gage having been broken, a new gage was established June 24, 1900. Later a pine board 10 feet long was spiked on top of the old gage, at the same elevation. November 5, 1904, a new gage was put in. This gage is in three sections. The first section is a pine board, graduated from zero to 3 feet, spiked to a pile 23 feet north of the initial point; the second section is painted on the downstream pier of the second set and graduated from 3 to 10 feet; the third section is painted on the upstream pier of the first set and is graduated from 10 to 29.5 feet. October 26, 1900, a bench mark was established on top of the bottom flange of the iron strut connecting the two iron cylinders at the south end of the highway bridge over the river; the bench mark is at the west end of the strut, next to the cylinder; its elevation is 12.19 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 218-219; WS 37, p 253; 50, p 318; 66, p 46; 84, p 95; 99, p 208; 131, pp 91-92.
Discharge: WS 27, p 95; 37, p 253; 50, p 318; 66, p 46; 84, p 96; 99, p 209; 131, p 92.
Discharge, monthly: Ann 21, iv, p 228; 22, iv, p 338; WS 75, p 144; 84, p 97; 99, p 211; 131, p 94.
Gage heights: WS 11, p 59; 37, p 254; 50, p 319; 66, p 47; 84, p 96; 99, p 209; 131, p 92.
Hydrographs: Ann 21, iv, p 229; 22, iv, p 338; WS 75, p 144.
Rating tables: WS 39, p 449; 52, p 518; 66, p 172; 84, p 97; 99, p 210; 131, pp 93-94.

Discharge measurements of Kansas River at Lecompton, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 14	W. G. Russell	744	2,104	2.55	3.20	5,366
May 27	do	778	6,164	3.39	7.80	20,920
May 28	do	771	5,546	3.39	7.00	18,800
June 5	Murphy and Russell	767	5,065	3.02	6.55	15,310
June 28	W. G. Russell	777	5,347	3.74	7.55	20,000
July 9	J. C. Stevens	801	9,866	5.00	12.35	49,310
August 4	W. G. Russell	764	4,573	3.34	6.60	15,250
September 22[a]	do	774	4,999	1.91	7.40	9,535
October 9	do	644	1,497	2.22	3.30	3,330

[a] Affected by backwater of Delaware River.

Daily gage height, in feet, of Kansas River at Lecompton, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	4.1	7.7	4.6	4.2	9.0	9.9	7.3	4.1	5.6	2.6	4.6
2	1.9	4.1	7.7	4.6	4.1	9.9	9.0	7.0	4.0	5.6	2.6	4.55
3	1.9	4.1	7.7	4.6	4.1	9.2	12.3	7.0	3.95	5.6	2.6	4.5
4	1.9	4.1	7.5	4.55	4.0	7.15	11.25	6.6	3.9	5.5	2.6	4.4
5	1.9	4.1	7.4	4.45	4.0	6.5	10.65	7.0	3.9	5.5	2.75	4.3
6	1.9	4.0	7.1	4.4	3.9	6.1	10.7	7.0	3.9	5.5	4.5	4.25
7	1.9	4.0	7.0	4.35	3.9	5.9	10.55	6.8	3.85	5.45	5.4	4.2
8	2.15	4.0	6.85	4.3	3.8	5.5	10.85	6.7	3.8	3.4	5.05	4.2
9	2.35	4.0	6.7	4.1	3.8	5.2	12.1	6.7	3.8	3.4	5.0	4.2
10	2.7	4.0	6.35	3.85	3.7	5.05	12.0	6.7	3.8	3.4	4.15	4.1
11	3.1	4.0	6.25	3.65	5.6	4.7	9.9	6.6	3.7	3.3	3.65	4.0
12	3.6	3.9	6.2	3.45	5.6	4.45	8.95	6.6	3.7	3.3	3.5	3.9
13	3.85	3.9	6.2	3.3	5.6	4.35	8.4	6.6	3.65	3.25	3.5	3.85
14	4.0	3.9	6.2	3.2	5.45	4.05	6.65	6.5	3.9	3.2	3.4	3.8
15	4.05	3.9	6.1	3.2	7.85	4.0	6.3	6.5	10.05	3.15	3.35	3.7
16	4.15	3.8	6.1	3.1	8.45	4.0	5.75	6.4	11.75	3.1	3.3	3.6
17	4.3	3.8	6.1	3.1	7.0	3.95	5.7	6.4	11.8	3.1	3.2	3.5
18	4.3	3.8	6.1	3.0	5.8	3.95	5.0	6.4	12.95	3.1	3.2	3.5
19	4.3	3.8	6.0	2.95	5.6	5.0	4.8	7.0	12.45	3.0	3.2	3.5
20	4.3	3.8	6.0	2.9	5.8	5.0	4.8	7.75	10.25	3.0	3.1	3.4
21	4.3	3.95	5.9	2.9	6.3	4.9	4.7	7.65	8.85	2.95	3.1	3.4
22	4.3	4.3	5.9	2.8	5.9	4.95	4.65	7.25	6.8	2.9	3.05	3.4
23	4.2	4.8	5.85	2.8	5.5	5.75	4.6	6.8	5.95	2.9	3.4	3.4
24	4.2	5.55	5.8	2.8	5.1	6.0	4.6	6.2	5.85	2.85	4.05	3.3
25	4.2	6.8	5.75	2.8	11.5	6.0	4.6	5.35	5.8	2.8	5.4	3.3
26	4.2	7.15	5.7	3.7	10.9	6.6	4.5	4.45	5.75	2.8	5.0	3.3
27	4.2	7.9	5.6	3.7	7.4	7.9	4.5	4.3	5.7	2.7	4.8	3.25
28	4.2	7.7	5.5	4.7	7.15	7.55	4.5	4.25	5.65	2.7	4.75	3.2
29	4.2	.....	5.0	4.5	6.7	8.0	5.1	4.2	5.6	2.7	4.7	3.2
30	4.2	.....	4.7	4.2	6.25	9.0	7.0	4.15	5.6	2.7	4.65	3.2
31	4.15	.....	4.6	.....	7.0	.....	6.85	4.1	.....	2.7	.....	3.2

Station rating table for Kansas River at Lecompton, Kans., from January 1 to September 21, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	2,525	3.40	5,600	4.90	9,600	7.80	21,100
2.00	2,700	3.50	5,850	5.00	9,900	8.00	22,100
2.10	2,875	3.60	6,100	5.20	10,500	8.20	23,100
2.20	3,050	3.70	6,350	5.40	11,100	8.40	24,200
2.30	3,250	3.80	6,600	5.60	11,750	8.60	25,300
2.40	3,450	3.90	6,850	5.80	12,450	8.80	26,400
2.50	3,650	4.00	7,100	6.00	13,200	9.00	27,500
2.60	3,850	4.10	7,375	6.20	13,950	9.50	30,300
2.70	4,050	4.20	7,650	6.40	14,750	10.00	33,300
2.80	4,250	4.30	7,925	6.60	15,550	10.50	36,550
2.90	4,475	4.40	8,200	6.80	16,400	11.00	39,800
3.00	4,700	4.50	8,475	7.00	17,300	11.50	43,200
3.10	4,925	4.60	8,750	7.20	18,200	12.00	46,900
3.20	5,150	4.70	9,025	7.40	19,100		
3.30	5,375	4.80	9,300	7.60	20,100		

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905, and is well defined between gage heights 6 feet and 8 feet.

Station rating table for Kansas River at Lecompton, Kans., from September 22 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.60	2,000	3.60	4,500	4.60	7,850	5.60	11,500
2.70	2,200	3.70	4,825	4.70	8,200	5.70	11,875
2.80	2,400	3.80	5,150	4.80	8,550	5.80	12,250
2.90	2,625	3.90	5,475	4.90	8,900	5.90	12,650
3.00	2,850	4.00	5,800	5.00	9,250	6.00	13,050
3.10	3,100	4.10	6,125	5.10	9,625	6.20	13,850
3.20	3,350	4.20	6,450	5.20	10,000	6.40	14,675
3.30	3,625	4.30	6,800	5.30	10,375	6.60	15,525
3.40	3,900	4.40	7,150	5.40	10,750	6.80	16,400
3.50	4,200	4.50	7,500	5.50	11,125	7.00	17,300

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905, and is not well defined.

Estimated monthly discharge of Kansas River at Lecompton, Kans., for 1905.

[Drainage area, 58,550 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	7,925	2,525	5,932	364,700	0.101	0.116
February	21,600	6,600	9,008	500,300	.154	.160
March	20,600	8,750	14,370	883,600	.245	.282
April	9,025	4,250	6,402	380,900	.109	.122
May	43,200	6,350	13,930	856,500	.238	.274
June	32,700	6,975	14,180	843,800	.242	.270
July	49,150	8,475	21,850	1,344,000	.373	.430
August	20,850	7,375	14,640	900,200	.250	.288
September	54,300	6,225	16,570	986,000	.283	.316
October	11,500	2,200	4,811	295,800	.082	.095
November	10,750	2,000	5,337	317,600	.091	.102
December	7,850	3,350	5,035	309,600	.086	.099
The year	54,300	2,000	11,010	7,983,000	.188	2.55

NOTE.—Ice conditions uncertain; discharge applied as for open channel.

BLUE RIVER NEAR MANHATTAN, KANS.

This station was established April 12, 1895. It is located at the county bridge 4 miles north of Manhattan, Kans.

The channel is straight for 200 feet above and below the station and has a width of 225 feet at ordinary stages. Both banks are subject to overflow during very high floods, the left bank being the lower of the two. The bed of the stream is composed of sand, clay, and silt and is free from vegetation and slightly shifting. There is but one channel at low stages; but during very high floods there are five channels or more. The current is sluggish at low and swift at high stages.

Discharge measurements are made from the bridge, which ordinarily spans the entire channel. The initial point for soundings is at the south end of the bridge.

The gage, which was read once each day during 1905 by J. M. Deckert, is in three sections. The first section, used for low-water readings, is a chain gage on the hand railing on the east

side and south end of the bridge, reading from zero to 14 feet from a scale spiked to the hand rail. The second section is an oak rod, reading from 11.3 to 17 feet, spiked to the north face of the south pier. The third section is a similar rod, graduated from 17 to 30 feet, bolted to the south side of the south pier. The gage is referred to bench marks, as follows: (1) A cross cut in the capstone of the south bridge pier immediately above the upper gage; elevation, 32.14 feet above gage datum. (2) A cross near the top of the second stone from the ground in the northwest corner of the south abutment; elevation, 27.32 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper).

Description: Ann 18, iv, pp 215-216; Bull 140, p 144; WS 16, p 115; 27, p 90; 37, p 252; 50, p 317; 66, p 46; 84, pp 97-98; 99, p 211; 131, p 111.

Discharge: Ann 18, iv, p 216; Bull 140, p 144; WS 16, p 115; 27, p 95; 37, p 252; 50, p 317; 66, p 46; 84, p 98; 99, p 212; 131, p 114.

Discharge, monthly: Ann 18, iv, p 218; 19, iv, p 348; 20, iv, pp 312, 319; 21, iv, p 227; 22, iv, p 337; WS 75, p 143; 84, p 99; 99, p 213; 131, p 117.

Discharge, yearly: Ann 20, iv, p 56.

Gage heights: Bull 140, p 145; WS 11, p 59; 16, p 115; 27, p 94; 37, p 253; 50, p 318; 66, p 46; 84, p 98; 99, p 212; 131, p 115.

Hydrographs: Ann 18, iv, p 219; 19, iv, p 349; 20, iv, p 319; 21, iv, p 227; 22, iv, p 337.

Rainfall and run-off relation: Ann 20, iv, p 313.

Rating tables: Ann 18, iv, p 217; 19, iv, p 348; WS 27, p 96; 39, p 449; 52, p 518; 66, p 172; 84, p 99; 99, p 213; 131, p 116.

Discharge measurements of Blue River near Manhattan, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 24	W. G. Russell	215	1,135	2.35	7.00	2,670
July 10	J. C. Stevens	223	1,470	2.67	9.33	3,926
August 16	W. G. Russell	208	556	1.86	5.80	1,032
October 5	do	212	601	2.06	6.10	1,234

Daily gage height, in feet, of Blue River near Manhattan, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	5.8	5.9	14.4	6.0	7.5	18.85	9.1	7.2	5.9	6.7
2	5.9	5.8	13.5	6.0	7.1	17.6	11.1	7.0	5.8	6.4
3	5.9	5.8	13.3	5.95	6.9	12.8	12.5	7.3	5.6	6.4
4	6.0	5.8	12.9	6.0	6.7	10.7	13.0	8.4	5.55	6.3
5	5.9	5.9	12.4	6.0	6.5	9.75	13.1	7.9	5.5	6.1
6	5.8	6.0	11.7	5.95	6.4	10.3	12.1	7.2	5.6	6.0
7	5.8	6.1	9.7	5.9	6.2	10.1	11.0	6.8	5.6	6.0
8	5.7	6.0	8.7	5.9	6.1	8.2	10.8	9.0	5.65	5.9
9	5.7	6.0	8.2	6.0	6.1	7.7	11.4	7.3	5.6	5.8
10	5.7	6.0	7.8	5.8	9.2	7.4	9.8	7.1	5.6	5.8
11	5.8	6.1	7.5	5.9	7.75	7.15	8.85	7.4	5.6	5.75
12	5.7	6.1	7.2	5.9	6.5	6.9	7.9	6.8	5.7	5.7
13	5.9	6.0	7.1	5.85	6.8	6.8	7.45	6.3	5.8	5.65
14	5.6	5.0	6.9	5.8	13.2	6.75	7.1	6.15	6.45	5.6
15	5.7	5.0	6.8	5.7	14.5	6.6	6.9	6.0	5.8	5.6
16	5.8	5.1	6.7	5.7	12.8	6.6	6.7	5.8	16.2	5.65
17	5.8	5.1	6.75	5.65	10.8	7.0	6.6	5.75	21.1	5.7
18	5.9	5.1	6.8	5.7	10.65	8.7	6.45	5.6	13.5	5.7
19	5.9	5.2	7.1	5.65	12.3	7.9	6.3	15.2	13.5	5.75
20	5.9	5.2	7.0	5.6	11.6	8.1	6.2	13.1	14.1	5.8
21	5.8	5.3	6.85	5.6	9.8	7.7	7.0	8.65	10.5	5.75
22	5.8	7.1	6.7	5.8	8.9	7.45	7.6	8.2	9.7	6.4
23	5.8	9.0	6.7	6.5	8.2	8.2	7.1	8.55	9.5	6.0
24	5.8	9.8	6.65	6.1	7.6	8.1	6.9	8.5	9.45	5.85
25	5.7	10.0	6.6	6.2	11.3	7.85	6.7	7.5	9.1	5.8
26	5.7	12.8	6.5	8.7	8.9	8.0	6.75	7.7	8.65	5.7
27	5.8	14.9	6.4	9.6	7.2	7.8	6.8	6.9	8.2	5.6
28	5.7	14.0	6.3	8.25	7.7	7.9	7.3	6.7	7.7	5.6
29	5.7	.....	6.2	8.0	9.2	9.6	7.5	6.45	7.3	5.5
30	5.9	.....	6.1	7.8	12.5	10.8	7.9	6.2	6.9	5.45
31	6.0	.....	6.1	.....	17.8	.....	8.0	6.1	.....	5.5

Station rating table for Blue River near Manhattan, Kans., from January 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.00	650	6.50	1,510	8.00	2,680	11.00	5,810
5.10	700	6.60	1,580	8.20	2,850	11.50	6,470
5.20	750	6.70	1,650	8.40	3,020	12.00	7,190
5.30	800	6.80	1,720	8.60	3,190	12.50	7,940
5.40	850	6.90	1,790	8.80	3,370	13.00	8,690
5.50	900	7.00	1,860	9.00	3,550	13.50	9,440
5.60	960	7.10	1,930	9.20	3,740	14.00	10,200
5.70	1,020	7.20	2,010	9.40	3,940	14.50	10,990
5.80	1,080	7.30	2,090	9.60	4,150	15.00	11,800
5.90	1,140	7.40	2,170	9.80	4,370	15.50	12,640
6.00	1,200	7.50	2,255	10.00	4,600	16.00	13,490
6.10	1,260	7.60	2,340	10.20	4,830	16.50	14,340
6.20	1,320	7.70	2,425	10.40	5,070	17.00	15,190
6.30	1,380	7.80	2,510	10.60	5,310	17.50	16,040
6.40	1,440	7.90	2,595	10.80	5,560	18.00	16,900

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903 and 1905, and is fairly well defined.

Estimated monthly discharge of Blue River near Manhattan, Kans., for 1905.

[Drainage area, 9,490 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,200	1,020	1,082	66,530	0.114	0.131
February	11,640	650	2,346	130,300	.247	.257
March	10,830	1,260	3,237	199,000	.341	.393
April	4,150	960	1,460	86,880	.154	.172
May	16,550	1,260	4,282	263,300	.451	.520
June	18,440	1,580	4,034	240,000	.425	.474
July	8,840	1,320	3,433	211,100	.362	.417
August	12,130	960	2,555	157,100	.269	.310
September	22,770	900	3,827	227,700	.403	.450
October	1,650	875	1,113	68,440	.117	.135
The period				1,650,000		

OSAGE RIVER DRAINAGE BASIN.

OSAGE RIVER AT OTTAWA, KANS.

Osage (Marais des Cygnes) River rises in the prairies of eastern Kansas, about 30 miles southwest of Topeka, and flows southeastward to its junction with the Missouri, near Jefferson City, Mo. The entire length of the stream, measured along the general trend of the valley, the minor bends being neglected, is about 280 miles, but its actual length is probably at least 500 miles, and the total area of the basin is about 15,300 square miles.

The eastern portion of the basin has a diversified surface, varying from the level alluvial bottoms of the streams to broken hilly uplands. It is covered with a thick growth of timber, including oak, elm, walnut, ash, maple, and many other varieties of trees. To the west the surface of the country becomes more gently undulating, the timber gradually disappears from the uplands, and the region finally merges with the great prairies which extend unbroken to the Rocky Mountains. The river winds through an alluvial bottom land, approaching first one bluff and then the other. The bed is generally gravel, especially on the shoals. The banks are gravelly and stable and range from 18 to 35 feet in height above low water. The stream has no mountain tributaries, but depends for its water supply entirely on the precipitation within its basin. This ranges from 35 to 40 inches each year. The basin contains no lakes or marshes of any extent.

The region is rich in mineral resources, and the gently rolling prairies of the western half and the valleys and river bottoms of the eastern half are well adapted to agriculture. About 62 per cent of the area is under cultivation and 10 per cent is timbered. Large quantities of coal are mined at Osage, Burlingame, Scranton, and Carbondale.

High water is frequent in the stream, but there is little danger of floods unless the rainfall is very heavy, sudden, or of long duration. The danger line is about 25 feet on the gage. The worst flood since the establishment of the gaging station at Ottawa was in 1904, when the water rose to 34.4 feet and flooded all the lower bottom lands, doing much damage to farms, towns, and cities along the course and stopping all railroad traffic for some time.

The gaging station was established August 26, 1902. It is located at the highway bridge on Main street near the center of the town of Ottawa, Kans.

The channel is slightly curved at the station, and both banks are high, but overflow at extreme flood stages. The bed of the stream is composed of rock, with small bowlders.

Discharge measurements are made from the highway bridge, which has a span of 135 feet between abutments and is somewhat oblique to the trend of the stream. The initial point

for soundings is the south end of the bridge, downstream side. At low stages the discharge can be measured by wading a short distance below the bridge.

The gage was read once each day during 1905 by W. H. Blacksten. The first gage was of the old wire type, with its scale spiked to the bridge floor. This gage was destroyed by the flood of May 30, 1904. A temporary gage was installed June 3, 1904. A new gage was put in September 9, 1904, as the water had left the temporary gage. This is a standard chain gage, placed on the outside of the hand rail on the downstream side of the bridge. The length of the chain is 30.9 feet. The gage rod is bolted to the hand rail and graduated from zero to 32 feet. The bench mark is the top of the hydrant cap on the north side of the river about 50 feet from the northeast corner of the bridge; elevation 31.34 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 41; 130, p 187.
Discharge: 99, p 42; 130, p 188.
Gage heights: 99, p 42; 130, p 188.

Discharge measurements of Osage River at Ottawa, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28	W. G. Russell	130	192	3.16	2.40	607
May 11	do	129	128	1.73	1.90	221
May 30	do	133	486	4.19	4.60	2,039
June 17	do	75	58	.67	1.40	39
August 17	do	77	64	.97	1.50	62
September 20	do	138	3,401	4.68	26.15	15,920
September 21	do	138	3,159	4.34	24.45	13,710
September 21	do	138	2,675	3.76	20.80	10,060
September 22	do	133	951	2.80	7.07	2,659
October 10	do	87	83	1.48	1.30	123

Daily gage height, in feet, of Osage River near Ottawa, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.4	1.3	2.5	2.9	1.9	2.5	1.9	2.6	1.35	1.6
2	1.4	1.3	2.0	2.6	1.8	2.2	6.55	2.2	1.3	1.5
3	1.4	1.3	2.0	2.4	1.7	2.1	24.8	2.0	1.3	1.5
4	1.4	1.3	1.9	2.3	1.7	2.0	25.45	2.1	1.8	1.5
5	1.3	1.3	1.8	2.2	1.7	2.0	23.2	3.1	1.6	1.5
6	1.3	1.3	1.6	2.15	1.7	1.9	9.25	2.3	1.7	1.45
7	1.3	1.3	1.6	2.1	1.7	1.8	3.2	2.0	1.7	1.4
8	1.3	1.3	1.6	2.1	1.7	1.8	2.7	1.8	1.7	1.3
9	1.3	1.3	1.5	1.9	2.1	1.6	2.6	1.7	2.3	1.3
10	1.3	1.3	1.6	1.9	2.2	1.6	2.7	1.6	12.35	1.3
11	1.3	1.3	1.5	1.8	2.0	1.5	2.5	1.6	8.6	1.3
12	1.3	1.3	1.4	1.7	1.8	1.5	2.2	1.5	3.1	1.3
13	1.3	1.3	1.5	1.7	2.2	1.5	2.15	1.5	2.2	1.3
14	1.3	1.3	1.5	1.7	2.1	1.45	2.0	1.5	2.1	1.2
15	1.3	1.3	1.5	1.7	2.1	1.4	1.9	1.6	15.35	1.2
16	1.3	1.3	1.5	1.6	2.0	1.4	1.9	1.5	23.45	1.2
17	1.3	1.3	1.45	1.6	1.9	1.4	1.8	1.4	17.85	1.2
18	1.3	1.3	2.9	1.6	1.8	1.35	1.7	3.55	21.95	1.15
19	1.3	1.3	3.3	1.6	1.7	1.6	1.7	10.8	26.28	1.4
20	1.3	1.3	3.1	1.55	1.6	1.8	1.7	3.4	26.18	1.3
21	1.3	1.3	2.5	1.6	1.6	1.7	1.6	2.9	22.15	1.2
22	1.3	2.15	1.65	1.55	1.5	1.6	1.6	2.0	5.35	1.2
23	1.4	4.2	2.2	1.6	1.5	1.6	1.6	1.8	2.7	1.2
24	1.3	5.9	2.9	1.5	1.5	1.5	1.5	1.7	2.6	1.2
25	1.2	6.0	3.05	1.6	3.55	1.5	1.5	1.7	2.2	1.2
26	1.4	4.9	2.4	2.3	16.08	1.4	1.5	1.5	2.0	1.3
27	1.3	3.3	2.15	2.6	14.45	1.5	7.5	1.5	1.9	1.2
28	1.3	2.8	11.27	2.4	3.48	1.5	9.7	1.4	1.7	1.3
29	1.2	.....	17.0	2.1	4.35	2.2	3.75	1.4	1.7	1.3
30	1.2	.....	12.4	2.0	4.4	2.0	2.5	1.4	1.6	1.3
31	1.3	.....	4.2	.....	3.2	.....	2.6	1.4	.....	1.3

GASCONADE RIVER DRAINAGE BASIN.

GASCONADE RIVER AT ARLINGTON, MO.

Gasconade River is formed by Piney, Lock, and Osage forks, which rise in southern Missouri and unite in Laclede and Pulaski counties. From the junction of the forks to the point where the Gasconade enters the Missouri the distance by general course is about 60 miles, but accurately measured along the stream it is probably over 100 miles. The basin comprises a total area of 3,667 square miles. The headwater region is an elevated table-land belonging to the Ozark Range of hills. The surface is irregular and along the streams becomes very rough and broken. The streams, which are bordered by alluvial bottom lands varying in width from a few hundred feet to a half mile, are supplied by a great number of springs, many of which are of large size.

The valley averages half a mile in width and is bordered by bluffs 100 to 200 feet high. The bed is usually gravel on the shoals, with considerable sand and mud in the pools. The banks are about 20 feet high on the lower river and show a deposit of alluvial soil, with sand- and gravel underneath. The rock occurring along the stream is mainly limestone and sand stone.

The gaging station was established April 11, 1903. It was at first located about 2 miles below Arlington, on the right bank of the river; but owing to the impossibility of maintaining a cable across the river during high water the station was moved July 27, 1904, to the

St. Louis and San Francisco railroad bridge, 1¼ miles upstream from the cable and one-fourth mile west of Arlington, Mo.

The channel is straight for about 1,000 feet above and below the bridge. Both banks are fairly high, partly wooded, and not liable to overflow except during very high stages. The bed of the stream is composed of clean gravel and rock and is practically permanent. There is a swift, direct current. At all stages the water passes between the abutments of the bridge.

Discharge measurements are made from the three-span railroad bridge, which has a total length of 431 feet between abutments. The meter is operated from the upstream lower chord of the trusses. The initial point for soundings is at the top of the inner face of the right abutment.

The gage was read during 1905 by C. W. Harrison. The gage at the old location was a vertical rod fastened to a leaning willow tree. The new gage is of the standard chain type. The length of the chain is 33.50 feet. The pulley center is 0.53 foot to the left of the zero of the gage, which is 117.01 feet from the initial point for soundings. The bench mark is located on the top surface of a cap on the upstream lower chord just to the right of the fifth panel point from the right abutment and is designated by a dent in the upper surface of the cap; elevation above gage datum 28.85 feet. The elevation of the pulley center above the zero of the gage is 32.75 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 36; 130, pp 188-189.
Discharge: 99, p 36; 130, p 190.
Discharge, monthly: 99, p 38; 130, p 191.
Gage heights: 99, p 37; 130, p 190.
Rating table: 99, p 37; 130, p 191.

Discharge measurements of Gasconade River at Arlington, Mo., 1904-5.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 11	F. W. Hanna	410	2,415	3.32	6.85	8,025
April 27	do	410	4,029	4.20	10.75	16,910
June 14	Hanna and Murphy	410	1,138	1.78	4.07	2,032
1905.						
April 7	M. S. Brennan	318	1,104	1.52	3.80	1,677
May 14	S. K. Clapp	413	1,944	2.93	5.75	5,700
June 21	F. W. Hanna	276	838	1.01	2.85	844
July 25	M. S. Brennan	416	2,049	2.58	6.16	5,283
September 7	do	323	1,071	1.38	3.81	1,479
October 11	do	312	982	1.36	3.55	1,334
December 9	do	301	948	1.32	3.41	1,255

NOTE.—Gage heights all refer to gage established July 26, 1904, at St. Louis and San Francisco railroad bridge.

Daily gage height, in feet, of Gasconade River at Arlington, Mo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.85	2.65	6.8	3.95	4.1	4.0	3.7	10.3	4.3	4.3	5.8	3.5
2	2.8	2.7	6.4	3.9	4.0	3.85	3.45	9.5	4.1	4.15	5.2	3.45
3	2.85	2.85	5.9	3.85	4.5	4.0	3.4	8.4	3.8	4.0	4.85	3.3
4	2.8	2.8	5.1	3.8	3.8	3.95	4.0	7.8	3.8	3.9	4.6	3.6
5	2.8	2.85	4.9	3.75	3.75	3.8	4.15	7.7	3.6	3.75	5.5	3.65
6	2.85	2.85	4.7	3.7	3.3	3.4	4.0	6.7	3.65	3.5	6.0	3.5
7	2.8	2.9	5.0	3.65	3.5	3.0	3.85	6.5	4.4	3.45	6.8	3.45
8	2.75	2.85	10.5	3.6	5.1	2.85	3.7	6.4	4.5	3.4	6.9	3.3
9	2.9	2.9	13.5	3.2	6.5	2.5	3.25	4.9	4.6	3.3	6.8	3.25
10	2.85	2.9	11.5	3.15	6.3	2.5	3.45	4.5	4.6	3.6	6.4	3.2
11	2.9	2.9	7.5	3.6	6.2	2.6	3.9	4.3	6.3	3.5	5.0	3.15
12	2.9	2.85	6.5	3.55	5.8	2.55	6.0	3.95	5.8	3.45	4.85	2.9
13	3.0	2.8	5.0	3.7	5.9	2.4	5.7	3.7	5.1	3.2	4.5	2.9
14	2.95	2.85	4.5	3.65	5.8	2.25	5.5	4.5	4.8	3.3	4.3	2.85
15	2.8	2.8	4.3	3.7	7.0	2.2	5.3	4.4	4.0	3.3	4.15	2.8
16	2.95	2.8	4.25	3.75	9.0	3.1	5.25	4.6	3.95	3.15	4.2	2.75
17	2.95	2.85	4.2	3.7	8.0	3.5	4.9	5.4	13.8	3.5	4.0	3.35
18	3.0	2.8	4.3	3.4	5.5	3.15	3.8	5.4	12.5	5.4	3.85	3.3
19	3.1	2.85	4.5	3.35	5.0	3.0	3.6	7.4	16.5	9.3	4.2	3.25
20	3.2	2.8	4.3	3.3	4.5	3.5	3.4	7.0	13.6	7.6	4.3	3.2
21	3.1	2.85	4.1	3.3	4.4	3.3	8.5	7.5	14.0	5.0	4.15	3.1
22	3.05	2.95	3.9	3.25	4.5	3.2	15.7	7.2	10.4	4.85	4.0	3.2
23	3.05	3.0	3.75	3.2	6.1	2.95	20.3	7.5	7.4	4.5	4.05	3.4
24	2.9	3.35	4.0	3.1	5.1	2.9	8.5	7.8	6.3	4.45	3.85	3.45
25	2.8	4.4	3.9	3.4	5.5	2.7	6.3	7.6	5.8	8.5	3.8	3.5
26	2.8	5.9	3.85	4.5	5.1	2.8	5.8	7.3	5.8	9.4	3.6	3.5
27	2.75	6.4	3.7	4.7	4.9	2.75	5.4	6.8	5.0	8.8	3.6	3.4
28	2.8	7.4	3.55	4.8	4.5	2.7	10.9	5.1	4.8	8.5	3.65	3.6
29	2.75	.....	3.75	4.8	4.3	3.2	16.3	5.0	4.7	5.9	3.6	3.75
30	2.7	.....	3.8	4.2	4.0	3.4	19.1	5.1	3.95	5.6	3.45	3.6
31	2.7	.....	3.9	.....	3.8	.....	18.4	4.8	.....	5.7	.....	3.8

NOTE.—Ice conditions not sufficient to modify flow.

Station rating table for Gasconade River at Arlington, Mo., from July 26, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
2.20	300	3.70	1,520	5.40	4,710	9.00	12,700
2.30	350	3.80	1,660	5.60	5,130	9.50	13,850
2.40	400	3.90	1,820	5.80	5,560	10.00	15,050
2.50	450	4.00	1,990	6.00	6,000	10.50	16,250
2.60	510	4.10	2,160	6.20	6,440	11.00	17,500
2.70	570	4.20	2,340	6.40	6,880	11.50	18,800
2.80	630	4.30	2,520	6.60	7,320	12.00	20,100
2.90	700	4.40	2,710	6.80	7,760	12.50	21,440
3.00	780	4.50	2,900	7.00	8,200	13.00	22,800
3.10	870	4.60	3,100	7.20	8,640	13.50	24,200
3.20	965	4.70	3,300	7.40	9,080	14.00	25,600
3.30	1,060	4.80	3,500	7.60	9,520	15.00	28,400
3.40	1,160	4.90	3,700	7.80	9,960	16.00	31,400
3.50	1,270	5.00	3,900	8.00	10,400	17.00	34,400
3.60	1,390	5.20	4,300	8.50	11,550	18.00	37,600

The above table is applicable only for open-channel conditions. It is based on twelve discharge measurements made during 1904–5, and is well defined between gage heights 2.8 feet and 10.75 feet. The table has been extended beyond these limits; above gage height 17 feet the rating curve is a tangent, the difference being 320 per tenth.

Estimated monthly discharge of Gasconade River at Arlington, Mo., for 1904 and 1905.

[Drainage area, 2,725 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
July	9,108	965	2,580	158,600	0.947	1.09
August	3,900	630	1,256	77,230	.461	.532
September	1,330	740	903	53,730	.331	.369
October	1,110	570	743	45,680	.273	.315
November	700	510	571	33,980	.210	.234
December	740	510	647	39,780	.237	.273
The period				409,000		
1905.						
January	965	570	696	42,800	0.255	0.294
February	9,080	540	1,456	80,860	.534	.556
March	24,200	1,330	4,908	301,800	1.80	2.08
April	3,500	870	1,641	97,650	.602	.672
May	12,700	1,060	4,341	266,900	1.59	1.83
June	1,990	300	899	53,490	.330	.368
July	44,960	1,012	9,534	586,200	3.50	4.04
August	15,770	1,520	6,744	414,700	2.47	2.85
September	32,900	1,390	7,710	458,800	2.83	3.16
October	13,620	918	4,195	257,900	1.54	1.78
November	7,980	1,215	3,350	199,300	1.23	1.37
December	1,660	600	1,104	67,880	.405	.467
The year	44,960	300	3,882	2,828,000	1.42	19.46

NOTE.—The estimate for July 26 to August 11, as published in the 1904 report, has been revised.

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 172.]

The publications of the United States Geological Survey consist of (1) Annual Reports, (2) Monographs, (3) Professional Papers, (4) Bulletins, (5) Mineral Resources, (6) Water-Supply and Irrigation Papers, (7) Topographic Atlas of United States—folios and separate sheets thereof, (8) Geologic Atlas of United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Union Trust Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Huntley, Mont.; Hazen, Nev.; Boise, Idaho; North Yakima, Wash.; Portland, Oreg., 351 Washington street.

Correspondence should be addressed to

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

AUGUST, 1906.

O

Water-Supply and Irrigation Paper No. 173 Series P, Hydrographic Progress Reports, 49

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART IX.—Meramec, Arkansas, Red, and Lower Western Mississippi River Drainages

BY

M. C. HINDERLIDER, J. M. GILES, and J. C. HOYT

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART IX.

By M. C. Hinderlider, J. M. Giles, and J. C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semi-arid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriation for hydrographic surveys for fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning

the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years, the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

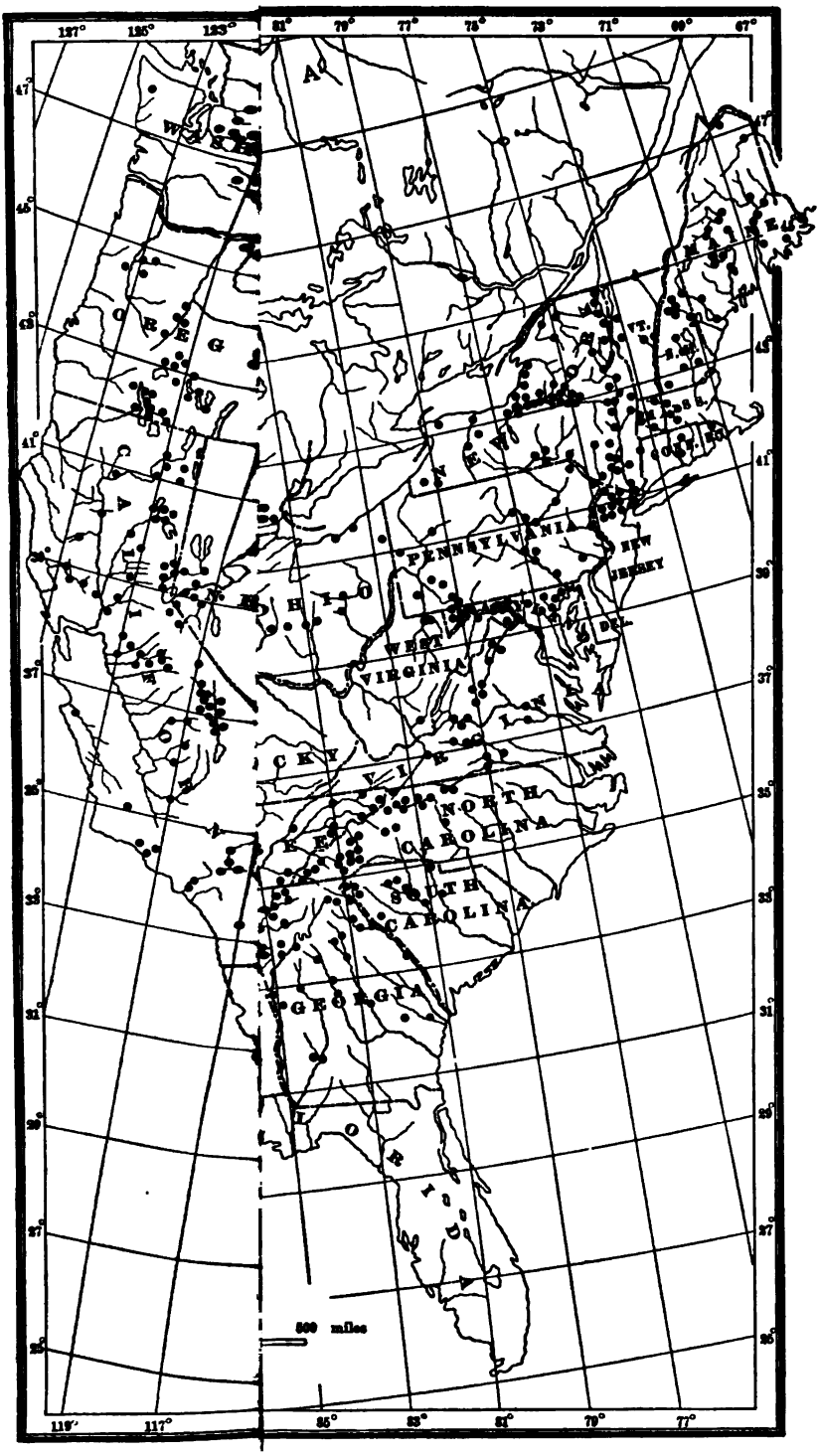
List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor southern Atlantic.


PENNSYLVANIA
NEW JERSEY
WEST VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
500 miles

DURING 1905.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most Stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as close as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; 0.125; 0.012; 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers one square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-feet.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equals about 1 kilowatt.
To calculate waterpower quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = Net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l \sqrt{h^3}$; l length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:

Scale 1 : 125,000, 1 mile=0.50688 inch.
Scale 1 : 90,000, 1 mile=0.70400 inch.
Scale 1 : 62,500, 1 mile=1.01376 inches.
Scale 1 : 45,000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given.

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (See Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leaking through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions

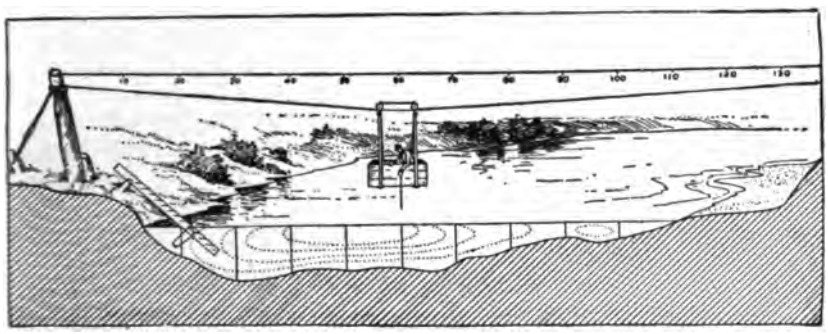


FIG. 1.—Cable station, showing section of river, car, gage, etc.

are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood

stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channnel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float observation is made of the time taken by the float to pass over the "run"—a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type so constructed that the impact of flowing water causes it to revolve and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical-velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, 4 times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained is 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the "subsurface" method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross-sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are

also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge varying thickness of ice. Such data as are available in regard to this subject are published in Water Supply paper No. 146, pages 141–148.

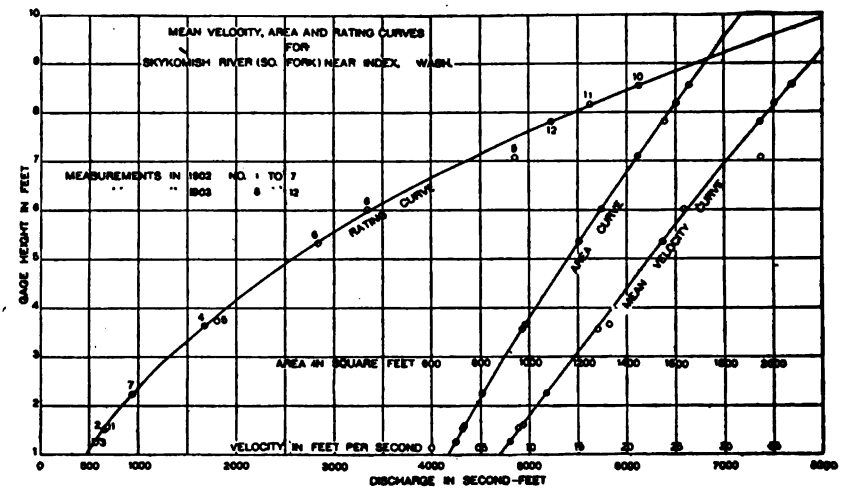


FIG. 2—Rating, area, and mean-velocity curves for South Fork of Skykomish River near Index, Wash

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations of streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the

time of measurement, the area of the cross-section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Arkansas.—District hydrographer, Thomas U. Taylor.[a]

Colorado.—District and resident hydrographer, M. C. Hinderlider,[b] assisted by R. I. Meeker, Wm. A. Lamb, H. G. Graham, A. A. Weiland, O. H. Timmerman, Melvin Beeson, Thomas E. Brick, and F. L. Meeker. Acknowledgements are due the Denver and Rio Grande, Colorado and Southern, Burlington and Missouri River, Union Pacific, Rio Grande Southern, and Atchison, Topeka and Santa Fe railroads for free transportation over their lines.

Kansas.—District hydrographer, M. C. Hinderlider, resident hydrographer, W. G. Russell Acknowledgments are due the Atchison, Topeka, and Santa Fe; Union Pacific; Missouri, Kansas and Texas; Missouri Pacific; and Chicago, Rock Island and Pacific railroads for annual passes issued to Mr. Russell.

Missouri.—District hydrographer, F. W. Hanna,[c] assisted by M. S. Brennan and S. K. Clapp. Acknowledgment should be made to the St. Louis and San Francisco Railroad for transportation furnished to Messrs. Hanna and Brennan.

New Mexico.—[d] The hydrographic work in the northern portion of this territory was carried on under the direction of M. C. Hinderlider, district hydrographer, assisted as follows: The work in the north-central portion was in charge of R. I. Meeker and the work in the northernwestern portion was in charge of O. H. Timmerman. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on Mora River acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of La Cueva, N. Mex.; also to James D. Hand, of Los Alamos, N Mex. Transportation in the form of annual passes was furnished Mr. Meeker by the Denver and Rio Grande and the Atchison, Topeka, and Santa Fe railroads.

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Oklahoma and Indian Territory.—The work in the southern part of Oklahoma and Indian Territory was under the direction of J. M. Giles, district hydrographer, assisted by Earl Patterson and E. R. Kerby. The work in the northern part was by W. G. Russell, resident hydrographer. Acknowledgments are due the Atchison, Topeka and Santa Fe; Missouri, Kansas and Texas; and Chicago, Rock Island and Pacific railroads for transportation furnished Mr. Russell; to the Southern Kansas of Texas; Chicago, Rock Island and Pacific; St. Louis and San Francisco; Fort Worth and Denver City; and Texas and Pacific railroads and Pecos Valley lines for transportation furnished Mr. Giles; to the Chicago, Rock Island and Pacific; and the St. Louis and San Francisco railroads for transportation furnished Mr. Kerby; and to the Southern Kansas of Texas and the Pecos Valley lines for transportation furnished Mr. Patterson.

Texas.—District hydrographer, Thomas U. Taylor.

MERAMEC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Meramec River rises in Dent County, Mo., flows northeast, and enters the Mississippi near St. Louis. This river drains a rugged, hilly, and comparatively thinly populated country. There are, however, numerous good sites for dams, and the United States Geological Survey is studying the river in connection with the possible water-power developments and for its possible use as a future water supply for the city of St. Louis.

The total drainage area of Meramec River is 3,619 square miles; at Eureka it is 3,497 square miles. The drainage area above Dry Fork is 340 square miles, and that of Dry Fork is 360 square miles.

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[a] Office of the district hydrographer for Arkansas, Texas, and Louisiana, Austin, Tex.

[b] Office of district hydrographer for Colorado Kansas, Nebraska, northern New Mexico, and Wyoming, Chamber of Commerce Building, Denver, Colo.

[c] District hydrographer for Missouri during 1906, A. H. Horton, 876 Federal Building, Chicago, Ill.

[d] District hydrographer for southern and eastern New Mexico, southern Oklahoma, and southern Indian Territory, J. M. Giles, Carlsbad, N. Mex.

MERAMEC RIVER NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located about 600 feet below the mouth of Spring Branch and about 1 mile from the post road between Meramec and St. James, Mo. The nearest railroad station is St. James, 7 miles northwest of the gaging station. The drainage area at this station is 340 square miles.

The channel is straight for about 300 feet above the station and for 2,000 feet below. The current velocity is sufficient for accurate measurement except at low stages, when it becomes sluggish. Both banks are low, and at high water the river spreads over wide flats. The bed of the stream is shifting.

Discharge measurements are made by means of a cable, boat, and tagged wire. The initial point for soundings has been taken at the tree to which the cable is attached on the left bank. At low stages measurements are obtained by wading the river about 200 feet above the mouth of Meramec Spring and adding to this discharge the flow of Meramec Spring.

The gage is a staff driven into the bed of the river and nailed at the top to a leaning tree. During 1905 the gage was read by C. C. Smallwood. The bench mark is a point on a bowlder on the left bank at the foot of the cliff near the mouth of Spring Branch; elevation, 10.44 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 233; 131, p 118.
Discharge: 99, p 234; 131, p 119.
Discharge, monthly: 99, p 235.
Gage heights: 99, p 234; 131, p 119.
Rating tables: 99, p 235.

Discharge measurements of Meramec River near Meramec, Mo., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
June 22	M. S. Brennan	2.79	164
July 26	do	3.60	438
September 8	do	2.79	168
October 12	do	2.92	174
December 20	do	2.96	256

Daily gage height, in feet, of Meramec River near Meramec, Mo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.75	2.75	4.5	4.4	3.7	3.0	3.1	3.4	2.9	3.3	3.7	3.1
2	2.75	2.75	4.1	4.1	3.6	2.9	3.1	3.3	2.9	3.2	3.6	3.6
3	2.75	2.75	3.9	3.9	3.5	2.9	3.0	3.2	2.8	3.1	3.5	3.8
4	2.75	2.75	3.8	3.7	3.4	3.0	3.0	3.1	2.8	3.1	3.5	3.6
5	2.75	2.75	3.8	3.6	3.4	2.9	2.9	3.0	2.8	3.1	4.9	3.5
6	2.75	2.75	5.1	3.6	3.3	2.9	2.9	3.0	2.8	3.0	4.8	3.4
7	2.75	2.75	7.2	3.5	4.6	2.9	2.8	3.4	2.8	3.0	4.3	3.3
8	2.75	2.75	8.0	3.4	4.1	2.8	2.8	3.3	2.8	3.0	4.1	3.2
9	2.75	2.75	6.4	3.3	4.0	2.8	2.9	3.2	2.8	3.0	4.1	3.1
10	2.75	2.75	5.0	3.3	3.8	2.8	3.2	3.1	3.0	3.0	3.7	3.05
11	2.75	2.75	4.8	3.6	3.8	2.8	4.5	3.3	2.9	2.95	3.6	3.0
12	2.75	2.75	4.4	3.6	3.8	2.8	3.7	3.0	2.8	2.9	3.5	3.0
13	2.75	2.75	4.1	3.6	3.7	2.8	3.6	3.0	2.8	2.9	3.4	3.0
14	2.75	2.75	3.9	3.4	7.2	2.8	3.4	2.9	1.8	2.9	3.3	2.95
15	2.75	2.75	3.8	3.3	4.8	2.8	3.3	3.4	1.8	2.9	3.3	2.95
16	2.75	2.75	3.7	3.1	4.4	2.8	3.2	3.1	2.75	2.9	3.3	2.9
17	2.75	2.75	3.7	3.1	4.2	2.8	3.0	3.0	7.0	2.9	3.2	2.9
18	2.8	2.75	3.5	3.1	4.0	2.8	3.0	3.0	8.2	2.9	3.2	2.9
19	2.8	2.8	3.5	3.0	3.8	2.8	2.9	3.0	7.8	3.6	4.7	2.9
20	2.9	2.8	3.5	3.0	3.5	2.7	2.9	2.9	6.0	3.4	4.9	2.95
21	2.9	2.9	3.4	2.9	3.4	2.9	6.9	2.8	5.6	3.3	4.3	2.95
22	3.1	3.0	3.4	2.9	3.4	2.7	6.1	5.4	5.1	3.2	3.9	2.95
23	3.1	3.9	3.4	2.9	4.0	2.7	4.8	4.2	4.3	3.1	3.7	3.0
24	3.1	4.0	3.5	2.9	3.9	2.7	4.0	3.9	4.2	3.6	3.6	3.0
25	3.0	5.6	3.6	2.9	3.6	2.8	3.7	3.8	3.9	4.4	3.5	3.0
26	2.9	5.3	3.4	4.1	3.5	2.9	3.6	3.4	3.7	5.9	3.4	2.95
27	2.9	5.9	3.4	4.0	3.4	2.9	3.7	3.1	3.5	4.0	3.3	2.95
28	2.8	4.6	3.3	3.8	3.4	2.9	3.7	3.1	3.4	3.9	3.3	3.0
29	2.75	.....	3.6	3.8	3.3	3.1	3.7	3.0	3.4	3.9	3.2	3.4
30	2.75	.....	5.3	3.8	3.4	3.1	3.4	3.0	3.3	3.9	3.2	3.3
31	2.75	.....	4.9	.....	3.1	.....	3.4	2.9	.....	3.8	.....	.....

MERAMEC RIVER NEAR EUREKA, MO.

This station was established August 26, 1903, by F. W. Hanna. It is located at the highway bridge on the road between Crescent and Eureka, Mo., about 1½ miles from Eureka, 2 miles below the mouth of Big River, and 2 miles above the Frisco Railroad bridge.

The channel is straight for about 250 feet above and 1,000 feet below the station. The right bank is high and rocky and not subject to overflow. It is wooded above the high-water line. The left bank is somewhat lower and is composed of alluvial soil, and it also is wooded above the high-water line. The bed of the stream is composed of coarse gravel and stones. The current is never sluggish. There is but one channel, and it is broken by the center pier of the bridge.

Discharge measurements are made from the two-span highway bridge with a length between abutments of 450 feet. The initial point for soundings is the inner face of the right abutment on the upstream side.

A standard chain gage is attached to the floor of the bridge; length of chain, 42.46 feet. During 1905 the gage was read by Mrs. Rhoda Hilderbran. Bench marks were established as follows: (1) A notch cut into the high rock cliff just below the bridge, marked by a painted cross and the letters "U. S. G. S.;" elevation, 38.26 feet. (2) A red mark on the top of the downstream guard rail, just above the gage box; elevation, 42.56 feet.

(3) A painted cross, surrounded by the letters "U. S. G. S," on the lower wing of the left abutment; elevation, 36.29 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 240; 131, p 120.
Discharge: 99, p 240; 131, p 120.
Discharge, monthly: 99, p 242; 131, p 123.
Gage heights: 99, p 241; 131, p 121.
Rating table: 99, p 241; 131, p 122.

Discharge measurements of Meramec River near Eureka, Mo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 6	M. S. Brennan	193	739	3.98	5.55	2,944
May 13	S. K. Clapp	223	932	4.16	6.05	3,881
June 21	M. S. Brennan	189	624	3.47	4.74	2,167
July 25	do	245	1,212	3.88	7.30	4,700
September 7	do	151	372	2.11	3.35	784
October 11	do	145	422	2.69	3.80	1,136
December 19	do	161	491	2.84	4.14	1,396

Daily gage height, in feet, of Meramec River near Eureka, Mo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	4.1	10.8	9.4	8.5	5.8	4.0	4.5	3.9	4.6	6.9	5.0
2	3.1	4.0	9.8	7.7	6.9	6.0	5.4	4.3	4.0	4.5	8.4	5.1
3	3.1	3.7	8.3	7.0	5.7	4.8	7.2	4.1	4.0	4.4	7.2	7.0
4	3.0	3.7	7.5	6.4	5.4	4.4	6.4	4.0	3.8	4.3	6.3	6.4
5	3.0	3.8	6.7	6.0	6.0	4.1	5.5	4.0	3.5	4.2	7.5	6.1
6	3.1	3.9	6.2	5.6	5.8	4.0	4.7	3.9	3.3	4.1	8.8	5.8
7	3.2	3.9	6.3	5.3	10.2	3.8	4.5	4.1	3.3	4.0	10.7	5.4
8	3.2	3.8	15.4	5.1	8.3	3.7	4.5	4.1	3.4	3.9	8.7	5.2
9	3.2	3.9	19.8	5.0	7.6	3.6	4.7	4.0	3.5	3.9	7.3	5.0
10	3.1	3.9	19.6	4.8	7.8	3.5	4.8	3.9	3.9	3.8	6.6	4.9
11	3.0	3.8	17.5	5.6	8.5	3.5	7.0	3.7	4.2	3.8	6.0	4.8
12	3.6	3.8	9.7	6.8	7.0	3.5	10.7	3.7	4.0	3.7	5.5	4.7
13	4.2	3.8	8.0	6.4	6.0	3.4	7.5	4.1	4.2	3.6	5.3	4.6
14	5.0	3.7	7.3	5.9	6.9	3.4	7.7	4.0	4.0	3.6	5.1	4.5
15	4.9	3.6	6.5	5.6	7.8	3.4	7.1	4.0	3.8	3.6	4.9	4.4
16	4.7	3.6	6.0	5.3	9.4	3.4	6.6	4.0	4.9	3.6	4.8	4.3
17	4.5	3.6	5.7	5.0	7.3	3.3	5.4	4.1	18.4	3.6	4.7	4.2
18	4.5	3.6	5.5	4.8	6.0	3.3	4.8	4.5	20.9	4.3	4.5	4.2
19	5.2	3.7	5.4	4.5	5.8	3.2	4.5	4.7	24.5	4.5	5.4	4.2
20	5.9	3.7	5.2	4.3	5.2	3.4	4.4	4.5	29.7	7.2	10.0	4.1
21	6.2	3.7	5.0	4.4	4.9	4.7	5.2	4.3	28.5	6.2	12.2	4.1
22	6.2	3.9	4.9	4.3	4.7	3.9	9.1	5.7	24.5	5.1	10.7	4.1
23	6.0	6.1	4.8	4.3	6.2	3.7	13.4	4.7	13.5	4.8	7.8	4.1
24	5.9	9.4	5.3	4.2	6.8	3.6	11.5	9.2	7.4	4.5	6.8	4.1
25	5.4	11.0	5.4	4.2	6.1	3.4	6.9	10.2	6.6	6.8	6.4	4.1
26	4.9	12.0	5.2	6.0	5.6	3.3	5.7	6.4	5.9	13.3	6.1	4.1
27	4.6	11.0	5.1	8.2	4.9	3.4	5.3	5.4	5.6	16.0	5.9	4.1
28	4.6	12.5	5.0	10.4	4.7	3.4	5.0	4.9	5.2	14.8	5.7	4.2
29	4.5	.....	5.1	12.2	4.5	3.5	4.7	4.5	5.0	8.5	5.5	5.3
30	4.3	.....	9.2	10.3	6.0	3.6	5.1	4.4	4.8	7.2	5.2	5.0
31	4.2	.....	11.1	.....	5.2	.....	4.9	4.0	.....	6.8	.....	5.6

Station rating table for Meramec River near Eureka, Mo., from August 8, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.60	460	4.40	1,700	6.40	3,810	9.80	8,050
2.70	490	4.50	1,790	6.60	4,030	10.00	8,330
2.80	530	4.60	1,880	6.80	4,250	10.50	9,040
2.90	580	4.70	1,980	7.00	4,470	11.00	9,790
3.00	640	4.80	2,080	7.20	4,710	11.50	10,540
3.10	710	4.90	2,180	7.40	4,950	12.00	11,340
3.20	780	5.00	2,280	7.60	5,190	12.50	12,190
3.30	850	5.10	2,380	7.80	5,430	13.00	13,090
3.40	920	5.20	2,490	8.00	5,670	13.50	14,040
3.50	990	5.30	2,600	8.20	5,920	14.00	15,040
3.60	1,060	5.40	2,710	8.40	6,180	14.50	16,040
3.70	1,130	5.50	2,820	8.60	6,440	15.00	17,050
3.80	1,200	5.60	2,930	8.80	6,700	16.00	19,100
3.90	1,280	5.70	3,040	9.00	6,960	17.00	21,100
4.00	1,360	5.80	3,150	9.20	7,220	18.00	23,100
4.10	1,440	5.90	3,260	9.40	7,490	19.00	25,100
4.20	1,520	6.00	3,370	9.60	7,770	20.00	27,120
4.30	1,610	6.20	3,590				

The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1903–1905. It is well defined between gage heights 2.8 feet and 6.2 feet. Two flood measurements at 11.6 and 25 feet gage heights, respectively, define the curve above this limit. Above gage height 20 feet the rating curve is a tangent, the difference being 210 per tenth. The left bank overflows at the approximate gage height of 22.2 feet. It has been estimated that the overflow at 36.2 feet gage height was 7,000 second-feet, or 50 second-feet, per tenth gage height.

Estimated monthly discharge of Meramec River near Eureka, Mo., for 1905.

[Drainage area, 3,497 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	3,590	640	1,727	106,200	0.494	0.570
February	15,040	1,060	3,055	169,700	.874	.910
March	26,640	2,080	6,715	412,900	1.92	2.21
April	11,680	1,520	3,694	219,800	1.06	1.18
May	8,610	1,790	3,991	245,400	1.14	1.31
June	3,370	780	1,255	74,680	.359	.400
July	13,850	1,360	3,836	235,900	1.10	1.27
August	8,610	1,130	2,102	129,300	.601	.693
September	51,160	850	9,451	562,400	2.70	3.01
October	19,040	1,060	3,532	217,200	1.01	1.16
November	11,680	1,790	4,511	268,400	1.29	1.44
December	4,470	1,440	2,119	130,300	.606	.699
The year	51,160	640	3,832	2,772,000	1.10	14.85

MERAMEC SPRING NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located on Spring Branch, 500 feet from the spring, at a footbridge. This point is about 1 mile from the mouth of Spring Branch and 2 miles above the mouth of Dry Fork.

The channel is straight for 50 feet above and 500 feet below the station. Both banks are of clay and gravel and are about 6 feet high. They will overflow only at unusual flood stages. The bed of the stream is composed of gravel with some bowlders and is clean. The water is very swift, making accurate gage readings very difficult.

Discharge measurements are made from the footbridge. The initial point for soundings is at the tree at the end of the footbridge on the right bank. The bridge was washed out in 1904 and was rebuilt about 50 feet downstream from its old location.

The gage is a staff 10 feet long located near the bridge. During 1905 it was read by C. C. Smallwood. The bench mark is located on the left corner stone of the breast wheel of the tail race just below the old breast wheel, and is designated by a cross on the top surface of the stone; elevation, 4.75 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Descripton: 99, pp 235-236; 131, p 123.
Discharge: 99, p 236; 131, p 124.
Discharge, monthly: 99, p 237; 131, p 125.
Gage heights: 99, pp 236-237; 131, p 124.
Rating table: 99, p 237; 131, p 125.

Discharge measurements of Meramec Spring near Meramec, Mo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 15	S. K. Clapp	55	75	6.50	1.70	488
June 22	M. S. Brennan	27	41	2.30	.37	95
July 26	do	29	51	3.98	.95	203
September 8	do	27	42	2.24	.40	94
October 12	do	27	43	2.63	.52	113
December 20	do	27	41	2.51	.40	103

Daily gage height, in feet, of Meramec Spring near Meramec, Mo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.25	0.25	0.9	1.0	0.9	0.7	0.5	0.8	0.5	0.8	0.9	0.6
2	.25	.25	.8	.9	.8	.7	.5	.7	.5	.8	.9	.8
3	.25	.25	.7	.9	.7	.6	.45	.7	.5	.75	.85	.8
4	.25	.25	.6	.8	.7	.6	.4	.6	.5	.75	.8	.75
5	.25	.25	.5	.8	.7	.5	.4	.5	.5	.7	1.2	.7
6	.25	.25	.7	.7	.7	.5	.4	.8	.5	.7	1.2	.7
7	.25	.25	1.5	.7	.8	.5	.4	.7	.5	.7	1.1	.6
8	.25	.25	2.5	.6	.7	.5	.4	.7	.45	.6	1.0	.6
9	.25	.25	2.1	.6	.8	.4	.4	.6	.45	.6	.95	.55
10	.25	.25	1.9	.6	.8	.4	.6	.6	.55	.6	.9	.55
11	.25	.25	1.5	.7	.8	.4	1.1	.7	.5	.55	.8	.5
12	.25	.25	1.4	.7	.8	.4	1.0	.7	.5	.55	.8	.5
13	.25	.25	1.2	.6	.8	.4	.8	.5	.45	.5	.75	.5
14	.25	.25	1.1	.6	1.9	.4	.7	.5	.45	.5	.7	.5
15	.25	.25	1.0	.6	1.7	.4	.7	.5	.45	.5	.7	.5
16	.25	.25	.9	.5	1.4	.4	.7	.5	.45	.5	.7	.5
17	.25	.25	.8	.5	1.2	.4	.6	.5	1.8	.5	.6	.5
18	.3	.25	.8	.5	1.0	.4	.5	.5	2.9	.5	.6	.5
19	.3	.25	.7	.5	.9	.4	.5	.5	2.6	.9	1.4	.45
20	.3	.3	.7	.4	.8	.4	.5	.5	2.3	.8	1.5	.45
21	.3	.3	.6	.4	.8	.5	1.9	.4	2.1	.6	1.3	.5
22	.3	.4	.6	.4	1.2	.45	2.0	.7	2.0	.6	1.2	.5
23	.3	.5	.6	.4	1.1	.4	1.7	1.1	1.9	.55	1.0	.5
24	.3	.7	.7	.4	1.0	.4	1.5	.9	1.3	.8	.95	.5
25	.25	.9	.8	.4	1.0	.4	1.1	.9	1.2	2.0	.9	.5
26	.25	1.5	.8	1.5	.9	.4	1.15	.8	1.0	2.8	.8	.5
27	.25	1.2	.7	1.2	.9	.4	.9	.8	.9	2.5	.8	.5
28	.25	1.1	.6	1.0	.9	.4	1.1	.8	.9	1.1	.75	.5
29	.25	.....	.9	1.0	.8	.4	1.0	.7	.8	.95	.7	.6
30	.25	.....	1.2	1.0	.8	.4	.6	.6	.8	.9	.65	.55
31	.25	.....	1.1	.....	.8	.....	.8	.5	.....	.9	.....	.....

COURTOIS CREEK AT SCOTIA, MO.

This station was established November 11, 1904. It is located at Scotia, a post-office 8 miles south of Leasburg, a small town on the St. Louis and San Francisco Railroad. The station may be reached by livery from Leasburg during low-water stages of Meramec River, and from Steelville by livery at all times.

The channel is straight for more than 200 feet above and below the station. The right bank is low, alluvial, and liable to overflow at ordinary high stages. The left bank is high and rocky and seldom overflows. The bed of the stream is clean below the overflow line and consists of coarse gravel. The current is direct and swift.

Discharge measurements are made by wading except at high stages, when a boat and tag line are used. A large tree at the wagon ford on the left bank is taken as the initial point for soundings.

The gage is a staff nailed to a leaning tree about 200 feet below the Scotia ford, on the left bank. The original gage and bench mark were destroyed, and a new gage and bench mark were put in at the same place April 9, 1905, but with the datum approximately 1.35 feet lower. All 1905 gage heights refer to the new datum. During 1905 the gage was read by Harry Lea. The bench mark is a spike driven into the tree at the gage; elevation, 6.69 feet above the datum of the new gage.

Discharge measurements of Courtois Creek at Scotia, Mo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 9	M. S. Brennan	122	167	2.04	3.00	340
May 16	S. K. Clapp	120	227	3.29	4.10	746
June 23	M. S. Brennan	109	81	2.22	2.13	180
July 27	do	115	138	3.05	3.15	426
September 9	do	110	99	2.54	2.57	252
October 13	do	111	85	2.34	2.35	199

Daily gage height, in feet, of Courtois Creek at Scotia, Mo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	2.65	4.65	.....	3.2	5.8	3.4	2.3	2.8	3.7	4.0	3.1
2	2.35	2.55	4.85	.....	3.0	4.0	2.2	2.4	2.7	3.5	3.8	3.0
3	2.35	2.45	4.35	.....	2.3	4.4	2.3	2.4	2.6	3.1	3.8	2.8
4	2.35	2.35	4.15	.....	2.4	4.0	2.5	2.4	2.4	3.1	3.4	2.8
5	2.35	2.85	4.35	.....	5.6	3.4	2.0	2.3	2.0	2.8	3.3	2.7
6	2.35	2.75	4.15	.....	6.0	3.2	2.1	3.0	1.0	2.8	3.3	2.7
7	2.35	2.55	.....	.....	6.0	3.0	1.1	3.2	1.8	2.8	3.2	2.7
8	2.35	2.45	.....	.....	5.8	2.9	1.3	3.4	1.0	2.7	3.0	2.7
9	2.35	2.15	8.35	.....	5.4	2.8	2.1	3.2	1.0	2.7	2.8	2.8
10	2.35	1.85	7.35	2.3	5.0	2.4	2.8	2.0	2.3	2.7	2.8	2.6
11	2.35	1.75	6.95	5.3	4.8	2.3	4.7	2.0	2.0	3.0	2.7	2.6
12	3.55	3.25	4.55	4.3	6.0	2.2	5.0	2.0	2.8	2.9	2.4	2.6
13	4.35	3.05	4.45	3.0	5.0	2.1	5.2	2.8	2.4	2.9	2.4	2.6
14	3.85	2.85	4.35	3.0	5.0	2.0	5.0	2.4	2.0	2.9	2.3	2.4
15	3.55	2.85	4.15	3.0	4.8	1.9	4.0	3.0	1.8	2.9	2.3	2.4
16	3.65	2.65	3.95	3.0	4.4	1.7	.....	3.6	1.8	2.9	2.2	2.4
17	3.75	2.55	3.85	2.8	4.2	1.6	.....	3.0	1.7	2.8	2.1	2.2
18	3.85	2.35	3.35	2.6	3.8	1.8	.....	2.8	1.7	2.8	1.8	2.2
19	3.85	2.75	3.35	2.4	3.7	1.8	.....	2.7	1.6	2.8	1.8	2.2
20	3.85	2.95	3.75	2.0	3.4	2.6	.....	2.3	.....	3.0	1.8	3.0
21	4.25	3.15	5.75	3.0	3.2	2.4	.....	2.0	.....	3.6	1.8	3.0
22	3.65	3.35	5.55	3.2	3.0	2.2	.....	2.0	.....	3.2	5.8	3.0
23	2.35	3.75	5.35	3.2	2.8	2.1	4.0	.....	6.0	2.8	5.0	2.8
24	2.65	4.35	.....	2.8	2.0	2.1	3.8	.....	5.0	2.8	4.6	2.7
25	2.75	5.85	.....	2.4	2.5	2.0	3.6	5.0	4.0	2.8	4.1	2.6
26	2.95	5.85	.....	4.0	2.4	2.0	3.4	5.4	4.8	2.8	3.8	2.4
27	2.95	5.55	.....	5.8	2.3	1.9	3.2	5.2	4.2	3.6	3.8	2.4
28	2.85	5.35	.....	4.3	3.2	1.8	3.0	4.0	4.0	.....	3.6	2.4
29	3.05	.....	.....	3.0	2.0	3.0	2.8	3.8	4.0	.....	3.3	2.4
30	2.95	.....	.....	3.4	.....	4.0	2.3	3.4	3.8	5.0	3.2	2.3
31	2.75	.....	.....	.....	6.0	.....	2.4	3.0	.....	4.0	.....	2.3

NOTE.—Water over gage March 7-8, May 30, August 23-24, September 20-22 October 28-29. Gage heights January 1 to March 31 may be somewhat in error, due to uncertainty of change in datum.

ARKANSAS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The western rim of the Arkansas basin is formed by three of the highest mountain ranges of Colorado—the Saguache, Sangre de Cristo, and Culebra, each having summits reaching over 14,000 feet in altitude. The melting of the almost perpetual snow which mantles the

high peaks near the north end of this rim furnishes water for three small creeks, known, respectively, as East, Lake, and Tennessee forks, and these, uniting near Leadville, form the Arkansas.

From the junction of the forks the river flows a little east of south for about 75 miles, then turns to the east and cuts through a canyon whose perpendicular walls attain elevations of over 2,000 feet above the water's edge, emerging finally into the plains region near Canyon. From Canyon to the Colorado-Kansas State line its general course is eastward for about 200 miles. Entering Kansas the river runs for 140 miles by general course a little south of east; it then makes a bold curve to the north, forming what is known as the Great Bend, below which it flows southeastward across Indian Territory to its junction with the Mississippi in northeastern Arkansas. The entire length of the stream from source to mouth, measured along the general course, is about 1,100 miles.

For about 120 miles from its source the river is a typical mountain torrent, descending in this distance from an elevation of 10,100 feet to about 5,300 feet. Its waters are clear and its bed is rocky. As it enters the plains region its gradient diminishes, its breadth increases it becomes unable at ordinary stages to carry the load of detritus collected in the more rapid portion above, and this detritus is gradually deposited, forming low, sandy banks and bars which block the course and cause the stream to shift its bed. At high stages this material is again caught up, the banks are eaten away, and very considerable changes of channel result from a single flood. The lower course of the river is bordered by wide alluvial bottoms, and the valley gradually merges with the valley of the Mississippi.

The drainage area as a whole is located a little south of the center of the United States, touching at its northernmost point latitude 39° 22′ N., and extending southward to latitude 33° 49′ N. Its eastern boundary is Mississippi River, its western the Rocky Mountains. The tract of country thus embraced comprises an area of approximately 188,000 square miles, and includes portions of Colorado, New Mexico, Kansas, Indian Territory, Texas, Missouri, and Arkansas. An area so immense necessarily presents great diversity in topography and resources. In the high mountains on the western border of the basin the passes range from 8,000 to 10,000 feet above sea, and some of the peaks tower to heights of over 14,000 feet. West of the one hundred and fifth meridian the country is generally mountainous and heavily timbered, and abounds in mineral wealth. Eastward stretch the seemingly endless rolling prairies of Colorado, Kansas, and Missouri. Throughout Indian Territory and Arkansas the country is more broken and includes a rough, mountainous section which extends across the northwest corner of Arkansas into southern Missouri. In the central part of Arkansas the surface is less rough and is largely a rolling prairie, with more or less timber interspersed. Toward the mouth of the river the country is low and heavily timbered and has a rich, black alluvial soil.

In its upper course the Arkansas is fed by numerous small streams, generally short, which lie wholly in or have their sources in the mountains. Those which head in the mountains and flow out onto the prairies are used more or less for irrigation. The most important of these tributaries are Greenhorn, Huerfano, Apishapa, and Purgatory rivers. East of the mountains the streams are all distinctively of the prairie type, and are bordered by bottom lands ranging from half a mile to 3 miles or more in width. In eastern Colorado and western Kansas the bottoms are light and sandy, but farther east they are alluvial in character. Rounded bluffs, 50 to 300 feet high, rise on both sides, and the country beyond is open and rolling. The stream beds are sandy—often quicksand—and muddy, there are no abrupt falls, and the streams run smoothly, with comparatively uniform descent. The plains tributaries include Black Squirrel, Horse, Two Butte, and Big Sandy creeks, Salt Fork, Cimarron, Verdigris, Grand, and Canadian rivers, and scores of smaller streams. The largest of these is Canadian River

The principal source of the water which the river bears to the plains is the precipitation along the crest of the high ranges. This is mainly in the form of snow and amounts to 20 or 30 inches each year. From the foothills to Arkansas City the precipitation ranges from 12

to 35 inches, being 25 to 35 inches in the last 100 miles below Hutchinson. The natural storage in the basin is limited to a few mountain lakes of glacial origin.

The streams of this drainage area are subject to floods of two kinds—the annual spring floods caused by the melting of the snows in the headwater regions; and floods caused by the violent storms, locally known as cloudbursts, in the foothills and plains regions. Occasionally, too, the river runs dry, and many of the tributaries are intermittent in character.

ARKANSAS RIVER NEAR CANYON, COLO.

The gaging station at Canyon, Colo., was established April 17, 1889, by Robert Robertson. It is located at the suspension footbridge at the Hot Springs Hotel, about 1 mile above the State penitentiary. This station is but a short distance below the mouth of Grape Creek, and at a point where the river leaves the mountains. Although there is an occasional break in the records, due to absence or changeof observer, they cover a period of seventeen years.

The station is of special importance, being located at the mouth of the canyon, at a point practically above the diversion of all water to the plains region, except the North and South Canyon ditches, both of which head above the station. During the irrigation season each of these ditches carries from 25 to 60 second-feet, according to the needs of the irrigators, and their discharge should be added to the discharge at the station in order to obtain the total run-off at the mouth of the canyon. No accurate records have been kept of the amount of water passing through these canals, although miscellaneous measurements have been made when measurements were made at the regular station. The estimated monthly discharges of Arkansas River at Canyon station do not include the water taken out by these canals.

The channel is straight for 500 feet above and 300 feet below the measuring section, and has a width of about 150 feet. The bed of the stream is rough, being composed of small bowlders, cobblestones, coarse gravel, and sand, and is not permanent from year to year, changing considerably with each high water. Both banks are high and rugged and are not liable to overflow. At times there are two channels, the main channel under the left bank, and a narrow channel discharging a few second-feet along the right bank. At high water there is but one channel. The gage heights range from 3 to 8 feet. The current is swift at all stages, exceptionally so at high water, and has a rough surface. Accurate measurements are difficult to obtain.

Discharge measurements were at first made from a cable and car, the bridge from which measurements were originally made by the State engineer having been destroyed. Later a new suspension bridge was constructed in front of the hotel, necessitating the removal and replacement of the gage, and subsequent measurements were made from this bridge. The initial point for soundings is marked on the floor of the bridge at the right bank, downstream side. A stay line is used for high-water measurements.

The gage established by Mr. Robertson in 1889 was an inclined staff attached to the crib of an old bridge, on the right bank of the river, almost directly in front of the hotel. Bench marks for this gage were as follows: (1) On the top of a log of the crib; elevation, 10.01 feet. (2) In the cleft of a red bowlder at the foot of a charred stump 50 feet downstream and on the same side of the river; elevation, 9.60 feet. (3) A bedded rock 40 feet from the north end of the cable, marked "B. M. No. 3, U. S. G. S.," 10 feet from the river bank; elevation 15.98 feet. Elevations refer to the datum of the gage.

A new gage was established October 4, 1895, on the opposite side of the stream, at the same datum. The channel had filled in about the Robertson gage and the top of the gage was broken off, making high-water readings impossible. December 27, 1895, the station was inspected, and it was found that readings had been made from the old rod, which at the stage of water prevailing recorded 0.40 foot above the new rod. When the water was high and extended with unbroken surface from bank to bank the readings were the same, but at low water the observations on the old rod were misleading, owing to the accumulation of sand and gravel in front of the gage.

August 26, 1902, because of the shifting of the channel, a new inclined gage rod was placed at the site of the previous rod, just below the north end of the suspension bridge. The datum of the gage was unchanged.

The present gage was established September 2, 1903, by the State engineer. It is located on the right bank just below the bridge, and consists of an inclined section reading from 0 to 7.3 feet, and a vertical section reading from 7.3 to 12 feet. The datum is the same as that of the preceding gage. During 1905 the gage was read twice each day by Dr. J. L. Prentiss. The bench mark is a cross cut in a bedded granite bowlder, 80 feet southeast of the south end of the suspension bridge, near the river bank; elevation, 16.07 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 11, ii, pp 47-48; 18, iv, p 225; Bull 131, pp 35-36; 140, p 156; WS 16, p 119; 28, p 107; 37, pp 258-259; 50, pp 323-324; 66, pp 48-49; 84, pp 133-134; 99, pp 297-298; 131, pp 126-128.

Discharge: Ann 14 ii, p 107; 18, iv, p 226; Bull 131, pp 90, 91, 92; 140, p 157; WS 16, p 119; 28, p 116; 37, p 259; 50, p 324; 66, p 49; 84, p 135; 99, p 299; 131, pp 128, 179.

Discharge, monthly: Ann 11, ii, pp 48, 97; 12, ii, pp 349, 360; 13, iii, p 94; 14, ii, pp 108-109; 18, iv, p 227; 19, iv, p 356; 20, iv, pp 329, 331-335; 21, iv, p 231; 22, iv, p 341; WS 75, p 145; 84, p 136; 99, p 301; 131, p 130.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 56.

Gage heights: Bull 131, pp 36-37; 140, p 157; WS 11, p 60; 16, p 119; 28, p 110; 37, p 259; 50, p 324; 66, p 49; 84, p 135; 99, p 299; 131, p 129.

Hydrographs: Ann 12, ii, p 242; 14, ii, p 107; 19, iv, p 357; 20, iv. p 336; 21, iv, p 231; 22, iv, p 341.

Rainfall and run-off relation: Ann 20, iv, p 330.

Rating tables: Ann 18, iv, p 226; 19, iv, p 355; Bull 131, p 36; WS 28, p 117; 39, p 450; 52, p 518; 66, p 172; 84, p 135; 99, p 300; 131, p 129.

Discharge measurements of Arkansas River near Canyon, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 17	R. I. Meeker	78	125	4.52	4.10	565
May 11	do	88	153	5.31	4.40	812
June 19	do	102	452	7.37	5.98	3,333
June 20	do	102	438	7.32	5.85	3,204
July 8	do	85	221	4.04	4.10	892
August 15	do	90	165	3.09	3.60	510
September 23[a]	do	60	104	2.91	3.20	303

[a] Made at different section.

Daily gage height, in feet, of Arkansas River near Canyon, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.75	3.8	3.8	4.65	5.6	5.0	4.25	3.5	3.0	3.35	3.4
2	3.8	3.7	3.8	3.8	4.9	6.05	4.85	4.4	3.4	3.05	3.4	3.45
3	3.75	3.8	3.8	3.8	4.75	6.65	4.65	4.35	3.35	3.3	3.4	3.5
4	3.7	3.8	3.85	3.7	4.5	7.1	4.5	4.25	3.4	3.35	3.45	3.4
5	3.7	3.8	3.9	3.75	4.5	7.4	4.35	4.2	3.35	3.35	3.65	3.4
6	3.7	3.8	4.05	3.8	4.4	7.0	4.2	4.1	3.3	3.25	3.7	3.4
7	3.7	3.8	4.35	4.05	4.4	7.05	4.2	4.05	3.3	3.1	3.7	3.4
8	3.7	3.7	4.2	4.1	4.4	7.25	4.15	4.0	3.3	3.1	3.6	3.4
9	3.7	3.7	3.85	4.15	4.5	7.5	4.15	3.85	3.3	3.1	3.55	3.3
10	3.6	3.65	3.75	4.4	4.5	7.65	4.25	3.8	3.3	3.0	3.4	3.3
11	3.6	3.55	3.7	4.0	4.4	7.25	4.25	3.75	3.3	3.0	3.4	3.3
12	3.5	3.4	3.7	4.0	4.4	7.05	4.25	3.75	3.3	3.0	3.3	3.3
13	3.45	3.55	3.7	4.1	4.35	7.0	4.25	3.75	3.2	3.05	3.25	3.3
14	3.5	3.7	3.7	4.15	4.3	6.9	4.25	3.7	3.2	3.1	3.2	3.3
15	3.65	3.65	3.75	4.1	4.25	7.0	4.25	3.75	3.2	3.2	3.3	3.3
16	3.85	3.75	4.05	4.1	4.35	6.65	4.25	3.92	3.2	3.25	3.3	3.35
17	3.85	3.95	4.1	4.0	4.45	6.4	4.2	3.9	3.2	3.3	3.3	3.4
18	3.8	3.95	4.0	3.9	4.65	6.15	3.95	3.85	3.2	3.3	3.3	3.3
19	3.8	3.9	4.0	4.0	4.75	5.95	4.05	3.8	3.2	3.3	3.3	3.3
20	3.8	3.9	4.0	4.0	4.95	5.8	4.15	3.75	3.2	3.3	3.3	3.25
21	3.8	3.9	3.9	4.0	5.1	5.6	4.3	3.75	3.2	3.3	3.3	3.2
22	3.8	3.9	3.8	3.9	5.25	5.8	4.3	3.8	3.2	3.25	3.3	3.2
23	3.8	3.9	3.75	4.1	5.45	5.6	4.25	3.8	3.15	3.3	3.3	3.2
24	3.8	3.9	3.75	4.35	5.5	5.4	4.25	3.95	3.1	3.3	3.3	3.2
25	3.85	3.85	3.8	4.45	5.5	5.5	4.15	3.85	3.1	3.3	3.3	3.2
26	3.8	3.8	3.8	4.5	5.5	5.45	4.15	3.8	3.0	3.3	3.35	3.2
27	3.8	3.8	3.8	4.45	5.5	5.35	4.0	3.75	3.0	3.3	3.4	3.1
28	3.8	3.8	3.8	4.7	5.5	5.25	5.85	4.5	3.0	3.3	3.45	3.05
29	3.8	.....	3.7	4.6	5.4	5.15	4.55	3.55	3.0	3.3	3.3	3.0
30	3.8	.....	3.7	4.8	5.3	5.1	4.1	3.5	3.0	3.3	3.35	3.0
31	3.85	.....	3.7	.....	5.3	.....	4.25	3.45	.....	3.3	.....	3.0

Station rating table for Arkansas River near Canyon, Colo., from January 1 to June 10, 1905

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	150	4.30	730	5.20	1,620	6.20	3,130
3.50	190	4.40	810	5.30	1,740	6.40	3,540
3.60	240	4.50	900	5.40	1,870	6.60	3,980
3.70	300	4.60	990	5.50	2,000	6.80	4,440
3.80	360	4.70	1,080	5.60	2,140	7.00	4,930
3.90	430	4.80	1,180	5.70	2,290	7.20	5,450
4.00	500	4.90	1,280	5.80	2,440	7.40	5,990
4.10	570	5.00	1,390	5.90	2,600	7.60	6,550
4.20	650	5.10	1,500	6.00	2,760		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and two during the early part of 1905. It is fairly well defined between gage heights 3.5 feet and 4.8 feet. Above gage height 4.8 feet the rating curve is very uncertain, being drawn to meet, at the highest gage height, the curve for the period following high water. It can be considered only a rough approximation.

Station rating table for Arkansas River near Canyon, Colo., from June 11 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	240	4.00	810	4.90	1,740	5.80	3,060
3.10	270	4.10	900	5.00	1,870	5.90	3,230
3.20	310	4.20	990	5.10	2,000	6.00	3,400
3.30	350	4.30	1,080	5.20	2,140	6.20	3,760
3.40	400	4.40	1,180	5.30	2,280	6.40	4,140
3.50	450	4.50	1,280	5.40	2,430	6.60	4,520
3.60	510	4.60	1,390	5.50	2,580	6.80	4,920
3.70	580	4.70	1,500	5.60	2,740	7.00	5,320
3.80	650	4.80	1,620	5.70	2,900	7.20	5,730
3.90	730						

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during the latter part of 1905. It is fairly well defined between gage heights 3.2 feet and 4.2 feet. The table has been extended beyond these limits, being based on two measurements near 6 feet. Above 6 feet it is uncertain.

Estimated monthly discharge of Arkansas River near Canyon, Colo., for 1905.

[Drainage area, 3,060 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	395	170	324	19,920	0.106	0.122
February	465	150	349	19,380	.114	.119
March	770	300	404	24,840	.132	.152
April	1,180	300	599	35,640	.196	.219
May	2,000	690	1,254	77,110	.410	.473
June	6,690	2,000	3,977	236,700	1.30	1.45
July	1,870	690	1,064	65,420	.348	.401
August	1,280	425	743	45,680	.243	.280
September	450	240	319	18,980	.104	.116
October	375	240	318	19,550	.104	.120
November	580	[illegible]	395	23,500	.129	.144
December	450	[illegible]	343	21,090	.112	.129
The year	6,690	150	841	607,800	.275	3.72

ARKANSAS RIVER AT PUEBLO, COLO.

The gaging station at Pueblo, Colo., was established in September, 1894, by A. P. Davis, at the Santa Fe Avenue Bridge. Since that time continuous records have been kept up at various bridges for a period of eleven years. This station is an important one, being located near the head of the principal irrigated portion of Arkansas Valley and above the headgates of the larger canals. For this reason water superintendents and commissioners depend on gagings made at this station for data by which distribution of the water is made to canals below.

The Arkansas River channel at Pueblo is the best confined stream in Colorado. Above the Victoria Avenue Bridge slag levees and dry rubble walls confine the channel in a somewhat irregular course. From Victoria Avenue Bridge to Main Street Bridge, a distance of 600 feet, the channel is straight, of uniform width, and with perpendicular masonry walls. At the lower side of the Main Street Bridge the masonry walls give way to hand-laid slag levees, which, though straight, bear at a slight angle to the left of the masonry walls. The

bed of the stream is composed of cobblestones, merging into coarse gravel and sand. There is but one channel at all stages. During extreme cold weather gage readings are discontinued, as the channel becomes obstructed with irregular masses and gorges of ice, which divide the stream into several channels. Gage heights range from 2 to 12 feet on the gage rod. During high water and its recession the channel is more or less shifting. During winter the channel fills in slightly and is scoured out again in the spring. The flow of the stream is rapid, but not too swift for accurate measurements.

Discharge measurements have been made principally from the Main Street Bridge, though some have been made at the Union Avenue Bridge. The Main Street Bridge consists of a single 151-foot span. A stay line is located 40 feet upstream and is used for measurements above gage height 4 feet. The initial point for soundings is the edge of the capstone of the right masonry retaining wall.

Originally there were two gage rods. The main gage was a vertical staff fastened to the left-bank abutment of the Denver and Rio Grande railroad bridge at Santa Fe avenue. There was also a short vertical rod for extreme low water fastened to a pile about 20 feet out in the stream. In June, 1895, an inclined staff gage was placed at the Victoria Avenue Bridge in order to determine the slope of the water surface. These rods were read until July 10, 1898, when, on account of the shifting of the bed of the river, they were abandoned, and a new gage was installed on the east side of the Main Street Bridge. Readings were made at the Main Street Bridge until March 3, 1900, when, owing to the scouring of the channel, a staff gage was fastened vertically to the masonry wall about 60 feet below the south end of the Union Avenue Bridge.

June 13, 1900, this rod was connected with a bench mark on the coping at the northwest corner of the Union Avenue Bridge, which was found to be 19.79 feet above the zero of the rod. In March, 1902, another rod was fastened vertically to the masonry wall on the right bank, about 30 feet above the south end of the Union Avenue Bridge. Gage heights from July 10, 1898, to July 14, 1902, were taken from the rod just below the Union Avenue Bridge. From July 14, 1902, until July 7, 1905, the readings were taken from the rod above the bridge. When the upper gage was set the datum was 0.2 foot higher than the lower gage. In all discharge measurements made in 1902 the gage height was taken from the rod above the Union Avenue Bridge.

In June, 1905, the gage above Union Avenue Bridge was rendered useless by shifting of the channel, and July 7, 1905, a standard chain gage was fastened to the upstream side of the Main Street Bridge, about 300 feet below the staff gage. The length of the chain is 19.32 feet. There are two markers, giving a range of 20 feet on a 10-foot scale. During 1905 the gage was read twice each day by David J. Cox. The bench mark is a cross painted on the footway at the gage-chain box; elevation, 18.60 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 11 ii, p 49; 18, iv, pp 227-228; Bull 140, p, 158; WS 16, p 120; 28, pp 107-108; 37, pp 259-260; 50, p 325; 66, pp 49-50; 84, pp 130-131; 99, pp 293-294; 131, pp 130-131.

Discharge: Ann 18, iv, p 228; Bull 131, p 90; 140, p 158; WS 16, p 120; 28, p 116; 37, p 260; 50, p 325; 66, p 50; 84, p 131; 99, p 295; 131, pp 132, 180.

Discharge, monthly: Ann 11, ii, pp 49, 98; 12, ii. p 360; 13, iii, p 94; 18, iv, p 230; 19, iv, p 357; 20, iv, pp 329, 336; 21, iv, p 232; 22, iv, p 342; WS 75, p 146; 84, p 133; 99, p 296; 131, p 133.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 56.

Gage heights: Bull 140, p 159; WS 11, p 61; 16, p 120; 28, p 111; 37, p 260; 50, p 326; 66, p 50; 84, p 132; 99, pp 295-296; 131, p 132.

Hydrographs: Ann 18, iv, p 231; 19, iv, p 357; 20, iv, p 337; 21, iv, p 232; 22, iv, p 342; WS 75, p 146.

Rainfall and run-off relation: Ann 20, iv, p 330.

Rating tables: Ann 18, iv, p 229; 19, iv, p 356; WS 28, p 117; 39, p 450; 52, p 518; 66, p 172; 84, p 132; 99 p 296; 131, p 133.

Discharge measurements of Arkansas River at Pueblo, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 4	R. I. Meeker	107	111	3.51	2.25	390
March 11	do	75	87	3.71	2.10	323
March 16	do	99	133	4.10	2.50	556
May 10	do	151	274	4.93	3.40	1,352
June 6	M. P. Beeson	150	835	8.15	6.75	6,804
June 7	R. I. Meeker	150	640	8.20	5.85	5,251
Do	do	150	655	8.03	5.90	5,257
June 20	do	150	410	6.80	4.25	2,765
June 24	do	150	396	6.70	4.15	2,655
July 7	do	149	196	4.06	2.72	796
August 9	do	151	230	4.35	3.02	1,000
September 23	do	80	102	2.65	2.15	270
November 4	do	89	119	2.97	2.30	353

Daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	1.95	2.4	4.05	4.05	4.3	3.35	3.3	2.4	2.05	2.35	2.55
2	2.1	1.95	2.4	2.9	3.9	4.75	3.15	3.35	2.4	2.08	2.33	2.55
3	2.05	1.95	2.4	2.8	3.75	5.1	3.0	3.05	2.35	2.05	2.33	2.52
4	2.05	1.95	2.3	2.6	3.6	6.3	2.95	2.95	2.4	2.38	2.35	2.45
5	2.0	1.95	2.3	2.55	3.5	6.55	2.85	2.85	2.35	2.32	2.42	2.45
6	2.0	2.0	2.3	2.55	3.45	6.6	2.75	2.85	2.55	2.3	2.6	2.48
7	2.0	2.0	2.7	2.8	3.35	6.05	2.55	3.25	2.7	2.2	2.62	2.48
8	2.0	2.0	2.75	2.9	3.35	6.25	2.65	3.15	2.55	2.12	2.58	2.48
9	2.0	2.0	2.65	2.85	3.55	6.55	2.8	2.95	2.4	2.05	2.5	2.5
10	1.95	2.0	2.45	2.9	3.45	6.6	2.75	2.95	2.35	1.95	2.38	2.5
11	1.95	2.0	2.2	2.75	3.35	6.0	3.0	2.85	2.45	1.97	2.4	2.5
12	1.95	2.0	2.1	2.75	3.3	5.7	3.0	3.0	2.3	2.03	2.35	2.48
13	1.9	2.0	2.1	2.75	3.25	5.7	2.85	2.75	2.25	1.97	2.3	2.52
14	1.9	2.0	2.2	2.75	3.25	5.6	2.85	2.55	2.3	2.0	2.25	2.52
15	1.9	2.0	2.35	2.75	3.2	5.45	2.8	2.55	2.3	2.0	2.28	2.52
16	1.9	2.0	2.4	2.7	3.2	5.25	2.9	2.85	2.25	2.07	2.28	2.52
17	1.9	2.0	2.6	2.75	3.2	5.15	2.85	2.9	2.2	2.05	2.3	2.52
18	1.9	2.0	2.6	2.6	3.45	4.8	2.7	2.85	2.2	2.2	2.28	2.52
19	1.9	2.0	2.5	2.65	3.55	4.65	2.5	2.75	2.2	2.23	2.28	2.5
20	1.9	2.05	2.5	2.65	4.1	4.2	2.7	3.1	2.2	2.17	2.22	2.5
21	1.9	2.1	2.4	2.55	4.2	4.0	3.0	2.75	2.2	2.2	2.22	2.48
22	1.9	2.15	2.4	2.45	4.35	3.85	3.2	2.55	2.2	2.2	2.2	2.42
23	1.9	2.2	2.3	2.7	4.45	3.9	3.0	2.35	2.15	2.27	2.25	2.38
24	1.9	2.25	2.3	3.4	4.6	3.85	2.8	2.55	2.15	2.25	2.3	2.4
25	1.9	2.3	2.25	3.5	4.6	3.8	2.75	2.7	2.12	2.25	2.25	2.4
26	1.9	2.35	2.25	3.95	4.45	3.7	2.8	2.65	2.1	2.23	2.22	2.42
27	1.9	2.4	2.35	3.75	4.45	3.7	3.05	2.65	2.08	2.2	2.3	2.4
28	1.9	2.4	2.4	3.75	4.4	3.65	2.65	2.4	2.05	2.2	2.3	2.4
29	1.9	.....	2.35	3.8	4.35	3.7	2.45	2.35	2.05	2.25	2.4	2.35
30	1.9	.....	2.3	3.85	4.15	3.45	3.05	2.5	2.05	2.27	2.48	2.3
31	1.9	.....	2.3	.....	4.1	.....	3.0	2.45	.....	2.3	.....	2.22

NOTE.—Gage heights during January and February have been reduced on account of ice conditions.

Station rating table for Arkansas River at Pueblo, Colo., from January 1 to June 10, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	255	3.10	1,130	4.20	2,650	5.30	4,330
2.10	300	3.20	1,250	4.30	2,800	5.40	4,490
2.20	350	3.30	1,370	4.40	2,950	5.50	4,650
2.30	410	3.40	1,500	4.50	3,100	5.60	4,810
2.40	480	3.50	1,630	4.60	3,250	5.70	4,975
2.50	560	3.60	1,770	4.70	3,400	5.80	5,140
2.60	640	3.70	1,910	4.80	3,550	5.90	5,305
2.70	730	3.80	2,050	4.90	3,705	6.00	5,470
2.80	820	3.90	2,200	5.00	3,860	6.20	5,800
2.90	920	4.00	2,350	5.10	4,015	6.40	6,130
3.00	1,020	4.10	2,500	5.20	4,170	6.60	6,460

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and seven measurements during the first part of 1905. It is fairly well defined.

Station rating table for Arkansas River at Pueblo, Colo., from June 11 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	200	2.40	420	2.80	770	3.20	1,230
2.10	240	2.50	500	2.90	870	3.30	1,360
2.20	290	2.60	580	3.00	980	3.40	1,490
2.30	350	2.70	670	3.10	1,100	3.50	1,630

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905. It is well defined.

Above 3.5 feet the table is the same as the preceding one. Changes in conditions due to flood make two tables necessary for 1905.

Estimated monthly discharge of Arkansas River at Pueblo, Colo., for 1905.

[Drainage area, 4,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	300	215	233	14,330	0.051	0.059
February	480	235	293	16,270	.064	.067
March	775	300	475	29,210	.103	.119
April	2,425	520	1,077	64,080	.234	.261
May	3,250	1,250	2,085	128,200	.453	.522
June	6,460	1,560	3,867	230,100	.841	.938
July	1,425	460	845	51,960	.184	.212
August	1,425	385	790	48,580	.172	.198
September	670	220	346	20,590	.075	.084
October	406	180	274	16,850	.060	.069
November	598	290	385	22,910	.084	.094
December	540	302	469	28,840	.102	.118
The year	6,460	180	928	671,900	.202	2.74

ARKANSAS RIVER NEAR SYRACUSE, KANS.

This station, established August 21, 1902, by W. G. Russell, is located on the highway bridge 1 mile south of Syracuse, Kans.

The channel above and below the station is straight and the water is sluggish. The right bank is low and liable to overflow; the left bank is high, and the bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank.

The gage is a staff fastened to the downstream pile of a bent, 158 feet from the initial point for soundings. During 1905 the gage was read once each day by Philip Botts. The bench mark is on the top of the east end of the first sill at the north end of the bridge. Elevation, 11.52 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 123; 99, p 269; 131, p 134.
Discharge: 84, p 123; 99, p 269; 131, p 134.
Discharge, monthly: 84, p 125; 99, p 271.
Gage heights: 84, p 124; 99, p 270; 131, p 135.
Rating tables: 84, p 124; 99, pp 270-271.

Discharge measurements of Arkansas River, near Syracuse, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 19	W. G. Russell	262	328	2.39	2.70	785
June 7	do	420	1,341	3.85	4.75	5,162
June 8	do	532	1,656	3.84	5.15	6,362
June 8	do	562	1,833	3.77	5.40	6,909
June 9	do	527	1,595	3.57	5.20	5,701
July 30	do	380	966	2.55	4.00	2,468
August 19	do	208	140	1.51	2.30	211

Daily gage height, in feet, of Arkansas River near Syracuse, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.3	1.9	2.5	2.0	5.0	4.3	2.8	3.5	2.4	1.9	2.0
2	1.5	1.9	2.5	3.0	4.9	4.3	2.7	6.3	2.2	1.9	2.0
3	1.4	2.0	2.3	5.25	4.8	4.6	2.6	6.1	2.3	1.9	2.0
4	1.7	2.5	2.3	5.0	4.7	4.0	2.5	4.7	2.0	1.9	2.0
5	1.7	2.5	2.1	4.0	4.6	4.0	2.8	4.2	2.4	1.8	2.1
6	1.8	2.5	2.1	3.5	4.5	4.3	2.8	3.7	2.4	1.8	2.1
7	2.0	2.5	2.0	3.5	4.4	4.7	2.7	3.2	2.3	1.8	2.1
8	2.0	2.5	2.0	3.1	4.3	5.4	2.6	3.7	2.3	1.8	2.0
9	2.0	2.5	1.8	2.9	4.0	5.2	2.5	3.5	3.4	1.8	1.9
10	1.8	2.5	1.8	3.1	3.9	5.4	2.4	3.2	3.2	1.7	1.9
11	1.8	2.5	1.8	3.1	3.8	5.1	2.4	3.1	3.0	1.8	1.9
12	1.7	2.5	1.8	3.1	4.4	5.1	2.0	3.1	2.7	1.8	2.0
13	1.7	2.8	1.8	3.2	4.6	5.0	1.9	2.8	2.6	1.8	2.0
14	1.5	2.8	1.8	3.4	4.4	5.0	1.8	2.7	2.6	1.8	2.0
15	1.5	2.8	1.8	3.1	4.2	4.7	2.2	2.7	2.6	1.8	2.0
16	1.7	2.8	1.8	3.1	4.2	4.7	1.9	2.6	2.4	1.8	2.1
17	1.8	2.8	1.9	2.8	4.2	4.7	1.8	2.6	2.3	1.8	2.0
18	1.9	2.8	1.9	2.8	4.2	4.5	1.8	2.6	2.4	1.8	2.0
19	2.0	3.0	1.8	2.7	4.2	4.5	1.8	2.5	2.4	1.8	2.0
20	2.4	3.0	1.8	2.7	4.8	4.3	1.8	2.2	2.4	1.8	2.0
21	2.4	3.3	2.5	2.7	4.8	4.0	1.8	2.0	2.3	1.8	2.0
22	2.0	3.4	2.4	2.6	4.5	4.5	1.8	2.1	2.3	1.8	2.0
23	2.0	3.5	2.2	2.6	4.4	4.3	1.8	2.2	2.3	1.8	2.0
24	1.8	3.5	2.0	3.5	4.2	3.7	2.3	2.0	2.0	1.8	2.1
25	1.8	3.3	2.0	7.25	6.5	3.5	2.4	1.9	2.0	1.8	2.1
26	1.5	3.0	1.8	6.5	4.7	3.5	2.5	1.8	2.1	1.8	2.1
27	1.5	3.0	1.8	5.05	5.0	3.4	2.7	1.8	2.0	1.8	2.1
28	1.5	2.8	1.9	6.25	5.0	3.3	2.5	3.3	2.0	1.8	2.2
29	1.7	.....	1.8	5.0	4.8	3.0	4.8	2.9	2.0	1.8	2.2
30	1.7	.....	1.7	5.0	4.7	2.9	4.3	2.6	1.9	1.8	2.3
31	1.8	.....	1.7	.....	4.5	.....	3.4	2.5	.....	2.0	.....

Station rating table for Arkansas River near Syracuse, Kans., from January 1 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	3	2.60	535	3.80	2,100	5.00	5,800
1.40	5	2.70	625	3.90	2,300	5.20	6,750
1.50	10	2.80	725	4.00	2,500	5.40	7,900
1.60	20	2.90	835	4.10	2,720	5.60	9,100
1.70	40	3.00	950	4.20	2,950	5.80	10,500
1.80	65	3.10	1,070	4.30	3,200	6.00	12,000
1.90	95	3.20	1,200	4.40	3,500	6.20	13,600
2.00	130	3.30	1,335	4.50	3,800	6.40	15,400
2.10	175	3.40	1,480	4.60	4,150	6.60	17,200
2.20	230	3.50	1,625	4.70	4,500	6.80	19,300
2.30	295	3.60	1,775	4.80	4,900	7.00	21,500
2.40	370	3.70	1,930	4.90	5,350	7.20	24,100
2.50	450						

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905 and three high-water measurements of 1903. It is not very well defined.

Estimated monthly discharge of Arkansas River near Syracuse, Kans., for 1905.

[Drainage area, 24,960 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	370	3	78.0	4,796	0.0031	0.0036
February	1,625	95	737	40,930	.030	.031
March	450	40	149	9,162	.0060	.0069
April	24,800	130	3,613	215,000	.145	.162
May	16,300	2,100	4,311	265,100	.173	.199
June	7,900	835	3,783	225,100	.152	.170
July	4,900	65	612	37,630	.025	.029
August	14,500	65	1,765	108,500	.071	.082
September	1,480	95	393	23,380	.016	.018
October	130	40	70.2	4,316	.0028	.0032
November	295	95	151	8,985	.0060	.0067
The period				942,900		

ARKANSAS RIVER NEAR DODGE, KANS.

This station was established November 28, 1902, by W. G. Russell, and is located one-fourth mile south of Dodge, on the highway bridge.

The channel both above and below the station is straight for about 100 feet. Both banks are low and liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank.

The gage is a staff fastened to the upstream pile of a bent 337 feet from the north end of the bridge. During 1905 the gage was read once each day by Alexander Alter. Bench marks were established as follows: (1) The top of the east end of the cap at the north end of the bridge; elevation 9.83 feet. (2) The top of the east end of the cap at the abutment of the south end of the bridge; elevation, 10.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 123; 99, p 268; 131, p 135.
Discharge: 84, p 123; 99, p 268; 131, p 136.
Discharge, monthly: 131, p 138.
Gage heights: 84, p 128; 99, pp 268-269; 131, p 137.
Rating table: 131, p 138.

Discharge measurements of Arkansas River near Dodge, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 18	W. G. Russell	455	435	1.98	2.10	865
June 10	do	482	1,616	3.42	3.90	5,519
June 11	do	485	1,624	3.79	4.10	6,150
June 11	do	487	1,757	4.14	4.40	7,273
July 31	do	467	570	2.59	2.70	1,476
August 18	do	264	100	1.31	1.70	131
September 24	do	34	5.4	.83	1.10	4.5

Daily gage height, in feet, of Arkansas River near Dodge, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.4	2.05	2.4	1.4	4.8	3.55	2.0	2.4	1.1	1.0
2	1.4	2.1	2.3	1.4	4.25	3.35	1.9	2.25	1.1	1.0
3	1.4	2.1	2.2	1.4	4.0	3.0	1.9	2.85	1.1	1.0
4	1.4	2.1	2.05	2.8	4.0	3.0	1.75	3.55	1.1	1.0
5	1.4	2.1	2.0	3.5	4.0	3.0	1.6	3.1	1.1	1.0
6	1.4	2.1	1.9	3.2	4.1	2.6	1.5	2.95	1.1	1.0
7	1.4	2.1	1.85	2.8	4.0	2.65	1.45	2.7	1.1	1.0
8	1.55	2.1	1.8	2.6	3.6	2.55	1.5	2.6	1.35	.9
9	1.75	2.1	1.8	2.5	3.55	3.85	1.4	1.95	1.5	.9
10	1.8	2.1	1.7	2.5	3.3	4.0	1.4	1.85	1.5	.9
11	1.8	2.1	1.7	2.4	3.0	4.0	1.4	1.8	1.5	.9
12	1.8	.9	1.7	2.3	2.6	4.0	1.35	1.7	1.45	.9
13	1.8	.9	1.7	2.3	3.65	4.0	1.3	2.05	1.4	.9
14	1.8	.9	1.6	2.3	3.65	4.0	1.2	1.95	1.5	.9
15	1.7	.9	1.6	2.5	3.55	4.0	1.2	1.85	1.45	1.0
16	1.7	.9	1.6	2.5	3.5	3.95	1.1	1.7	1.4	1.0
17	1.7	.9	1.6	2.35	3.65	3.6	1.1	1.7	1.1	1.1
18	1.7	.9	1.6	2.15	3.7	3.5	1.1	1.35	1.1	1.2
19	1.7	.9	1.6	2.15	3.5	3.35	1.05	1.3	1.1	1.2
20	1.8	.9	1.6	2.2	3.5	3.6	1.0	1.4	1.1	1.3
21	1.8	.9	1.6	2.2	4.5	3.4	1.0	1.3	1.1	1.3
22	1.85	.9	1.5	2.2	4.65	3.2	1.1	1.2	1.1	1.3
23	1.95	1.0	1.4	2.3	4.35	3.2	1.1	1.2	1.1	1.3
24	1.9	2.5	1.5	2.6	4.0	3.2	1.1	1.2	1.05	1.3
25	1.9	2.6	1.5	3.0	4.75	2.9	1.1	1.1	1.0	1.3
26	1.9	2.6	1.5	6.25	4.25	2.5	1.1	1.1	1.0	1.3
27	2.0	2.8	1.5	5.25	3.5	2.4	1.0	1.1	1.0	1.3
28	2.0	2.55	1.4	4.75	4.25	2.35	1.0	1.1	1.0	1.3
29	2.0	.....	1.4	5.45	5.9	2.15	1.0	1.0	1.0	1.3
30	2.0	.....	1.3	4.75	4.25	2.0	1.3	1.0	1.0	1.3
31	2.0	.....	1.3	.....	4.0	.....	2.5	1.0	.....	1.4

NOTE.—River frozen January 1 to February 23, approximately.

Station rating table for Arkansas River near Dodge, Kans., from January 1 to June 12, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	180	2.40	1,335	3.50	4,100	4.60	8,110
1.40	225	2.50	1,530	3.60	4,425	4.70	8,550
1.50	280	2.60	1,735	3.70	4,760	4.80	9,000
1.60	345	2.70	1,950	3.80	5,100	4.90	9,465
1.70	420	2.80	2,175	3.90	5,450	5.00	9,950
1.80	505	2.90	2,410	4.00	5,800	5.20	10,930
1.90	605	3.00	2,660	4.10	6,160	5.40	11,910
2.00	720	3.10	2,920	4.20	6,530	5.60	12,900
2.10	850	3.20	3,195	4.30	6,910	5.80	13,920
2.20	995	3.30	3,485	4.40	7,300	6.00	14,950
2.30	1,155	3.40	3,785	4.50	7,700		

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during April to June, 1905. Owing to the shifting character of the stream bed and insufficient measurements, the above table is very uncertain.

Station rating table for Arkansas River near Dodge, Kans., from June 13 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	2	1.80	200	2.60	1,255	3.40	3,425
1.10	4.5	1.90	275	2.70	1,460	3.50	3,770
1.20	10	2.00	370	2.80	1,685	3.60	4,125
1.30	20	2.10	480	2.90	1,930	3.70	4,490
1.40	35	2.20	605	3.00	2,195	3.80	4,860
1.50	60	2.30	745	3.10	2,480	3.90	5,235
1.60	95	2.40	900	3.20	2,780	4.00	5,620
1.70	140	2.50	1,070	3.30	3,095		

The above table is based on three discharge measurements made during July and August, 1905. See note to table above.

Estimated monthly discharge of Arkansas River near Dodge, Kans., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
February 24-28	2,175	1,530	1,761	17,460
March	1,335	180	453	27,850
April	16,300	225	3,126	186,000
May	14,430	1,735	5,772	354,900
June	5,800	370	3,285	195,500
July	1,070	2	86.0	5,288
August	3,948	2	545	33,510
September	60	2	17.1	1,018
October	35	1	9.8	603
The period				822,100

NOTE.—No estimate for ice period.

ARKANSAS RIVER AT HUTCHINSON, KANS.

This station was established May 13, 1895, and was discontinued October 31, 1905. It is located at the wagon bridge at the south end of Main street, Hutchinson, Kans.

The channel is straight for some distance above and below the bridge and has a width of 1,020 feet, broken by 11 steel piers. The bed is sandy and very shifting, necessitating frequent discharge measurements and soundings. At low water the stream subdivides into a number of small channels.

Discharge measurements are made from the bridge at high water; at low water they can be made by wading.

The gage is a staff fastened to the downstream pier of the third bent from the north end of the bridge. During 1905 the gage was read once each day by George E. Dixon. Bench marks were established as follows: (1) The upper crosspiece of the pier guard; elevation, 8.35 feet. (2) The top of the iron doorsill of the first brick building next to the river; elevation, 8.12 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS = Water-Supply Paper):

Description: Ann 18, iv, pp 232-233; 20, iv, p 342-343; Bull 140, pp 160-161; WS 16, p 124; 28, p 109; 37, p 265; 50, p 330; 66, p 56; 84, p 120; 99, p 266; 131, p 139.

Discharge: Ann 18, iv, p 233; Bull 140, p 161; WS 16, p 124; 28, p 116; 37, p 265; 50, p 330; 66, p 56; 84, p 121; 99, p 266; 131, p 139.

Discharge, monthly: Ann 18, iv, p 234; 19, iv, p 361; 20, iv, pp 329, 343; 21, iv, p 236; 22, iv, p 344; Bull 140, p 162; WS 75, p 147; 84, p 122; 99, p 267; 131, p 141.

Discharge, yearly: Ann 20, iv, p 57.

Gage heights: Bull 140, p 161; WS 11, p 62; 16, p 124; 28, p 114; 37, p 265; 59, p 330; 66, p 56; 84, p 121; 99, pp 266-267; 131, p 140.

Hydrographs: Ann 18, iv, p 234; 19, iv, p 361; 20, iv, p 343; 21, iv, p 237; 22, iv, p 344; WS 75, p 148.

Rainfall and run-off relation: Ann 20 iv, p 330.

Rating tables: Ann 18, iv, p 234; 19, iv, p 360; WS 28, p 117; 39, p 450; 52, p 518; 66, p 172; 84, p 122; 99, p 267; 131, p 140.

Discharge measurements of Arkansas River at Hutchinson, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 20	W. G. Russell	398	554	2.58	2.80	1,432
May 26	do	762	1,505	3.83	4.80	5,764
June 12	do	532	1,250	3.19	4.20	3,985
June 13	do	668	1,442	3.31	4.55	4,779
June 14	do	568	1,164	3.18	4.15	3,697
August 3	do	408	469	2.26	2.60	1,059
August 20	do	312	228	1.96	1.85	446
September 23	do	131	87	1.85	1.40	161

Daily gage height, in feet, of Arkansas River at Hutchinson, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.95	2.25	3.48	2.05	5.57	5.0	3.2	2.6	1.4	1.3
2	1.95	2.25	3.4	2.0	5.5	5.0	3.25	2.5	1.32	1.3
3	1.95	2.25	3.4	2.05	5.15	4.75	3.2	2.5	1.22	1.3
4	1.95	2.25	3.25	2.05	4.85	4.4	3.05	2.8	1.2	1.3
5	1.95	2.25	3.05	2.05	4.7	4.2	3.0	2.9	1.2	1.3
6	1.85	2.25	3.0	2.1	4.5	3.95	2.7	3.0	2.2	1.25
7	1.75	2.25	2.9	3.82	4.5	3.6	2.45	3.4	2.15	1.2
8	1.55	2.25	2.9	3.45	4.4	3.5	2.25	3.5	1.95	1.2
9	1.5	2.25	2.8	3.3	4.6	3.35	2.2	3.4	1.9	1.2
10	1.5	2.25	2.7	3.18	4.45	3.3	2.2	3.25	1.9	1.2
11	1.5	2.25	2.6	3.05	4.25	4.3	2.22	3.05	1.9	1.2
12	1.5	2.25	2.6	2.95	4.05	4.1	2.3	2.75	1.9	1.2
13	1.5	2.25	2.52	2.9	3.85	4.4	2.2	2.4	1.85	1.15
14	1.5	2.25	2.4	2.8	3.9	4.2	2.05	2.3	1.8	1.15
15	1.5	2.2	2.4	2.7	3.8	4.3	1.92	2.3	1.75	1.15
16	1.5	2.15	2.4	2.7	3.85	4.6	1.9	2.25	1.7	1.15
17	1.6	2.05	2.4	2.75	3.85	4.35	1.9	2.2	1.65	1.15
18	1.7	2.0	2.5	2.8	3.75	4.25	1.85	2.1	1.6	1.2
19	1.7	2.0	2.5	2.75	3.8	4.15	1.8	1.95	1.55	1.2
20	1.8	2.0	2.6	2.75	3.85	4.1	1.8	1.85	1.5	1.2
21	1.95	2.25	2.5	2.7	4.05	4.0	1.7	1.9	1.45	1.2
22	2.2	2.4	2.4	2.7	3.95	3.85	1.77	1.87	1.4	1.2
23	2.2	2.5	2.3	2.6	4.8	4.2	1.8	1.8	1.4	1.2
24	2.2	2.5	2.2	2.6	5.2	3.65	1.85	1.7	1.35	1.2
25	2.2	2.78	2.2	2.7	4.8	3.5	1.7	1.67	1.35	1.2
26	2.25	3.5	2.2	2.82	4.65	3.4	1.7	1.62	1.35	1.2
27	2.25	2.9	2.15	4.1	4.95	3.15	1.7	1.6	1.35	1.2
28	2.25	3.5	2.1	5.42	4.9	3.15	1.7	1.6	1.35	1.2
29	2.25	.....	2.1	5.4	4.95	2.92	1.7	1.5	1.3	1.2
30	2.25	.....	2.05	5.4	5.05	3.15	2.4	1.4	1.3	1.25
31	2.25	.....	2.05	.....	5.58	.....	2.6	1.4	.....	1.3

Station rating table for Arkansas River at Hutchinson, Kans., from January 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	80	2.20	660	3.30	2,065	4.40	4,390
1.20	95	2.30	750	3.40	2,240	4.50	4,650
1.30	120	2.40	850	3.50	2,420	4.60	4,920
1.40	150	2.50	960	3.60	2,605	4.70	5,205
1.50	190	2.60	1,070	3.70	2,800	4.80	5,500
1.60	240	2.70	1,190	3.80	3,005	4.90	5,800
1.70	300	2.80	1,320	3.90	3,220	5.00	6,100
1.80	360	2.90	1,460	4.00	3,440	5.20	6,730
1.90	430	3.00	1,600	4.10	3,670	5.40	7,380
2.00	500	3.10	1,750	4.20	3,900	5.60	8,050
2.10	580	3.20	1,900	4.30	4,140		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905, and is fairly well defined.

Estimated monthly discharge of Arkansas River at Hutchinson, Kans., for 1905.

[Drainage area, 34,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	705	190	430	26,440	0.013	0.015
February	2,420	500	866	48,100	.025	.026
March	2,384	540	1,112	68,370	.033	.038
April	7,446	500	1,965	116,900	.058	.065
May	7,982	2,902	4,838	297,500	.142	.164
June	6,100	1,488	3,470	206,500	.102	.114
July	1,982	300	743	45,680	.022	.025
August	2,420	150	882	54,230	.026	.030
September	660	95	257	15,290	.0076	.0085
October	120	88	99.5	6,118	.0029	.0033
The period				885,100		

ARKANSAS RIVER AT ARKANSAS CITY, KANS.

This station was established September 23, 1902, by W. G. Russell. It is located on the Chestnut Avenue Bridge, one-half mile west of Arkansas City, Kans.

The channel is straight for about 200 feet above and below the station and has a width of 550 feet, broken by 36 pile piers. Both banks are low and liable to overflow. The bed of the river is sandy and shifting. The current is moderately rapid.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank.

The gage is a staff fastened to the downstream pile of the second bent from the east end of the bridge. During 1905 the gage was read daily by T. C. White. Bench marks were established as follows: (1) the top of the cap on the pile which carries the gage; elevation, 17.20 feet. (2) A nail driven into the south pile of the bent of the east abutment; elevation, 11.97 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 84, p 119; 99, p 263; 131, p 141.
Discharge: 84, p 119; 99, p 264; 131, p 142.
Discharge, monthly: 99, p 265; 131, p 144.
Gage heights: 84, p 120; 99, p 264; 131, p 142.
Rating table: 99, p 265; 131, p 143.

Discharge measurements of Arkansas River at Arkansas City, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 21	W. G. Russell	219	541	2.60	4.40	1,407
May 5	do	366	1,767	3.79	7.70	6,693
May 6	do	345	1,579	3.59	7.30	5,672
June 15	do	325	1,459	3.10	6.90	4,529
July 27	do	156	398	1.39	3.30	533
August 21	do	197	407	2.22	3.90	905
September 27	do	170	432	1.30	3.55	564

Daily gage height, in feet, of Arkansas River at Arkansas City, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.1	4.1	5.4	4.3	8.7	9.0	5.0	7.6	2.5	3.2
2	3.1	4.0	5.6	4.2	9.0	9.3	5.3	7.0	2.4	3.1
3	3.0	3.8	5.7	4.1	9.2	9.2	5.6	6.0	3.2	2.9
4	3.0	3.7	5.8	4.2	8.3	8.5	7.0	5.5	2.2	2.9
5	2.9	3.8	5.8	4.1	7.7	8.1	8.1	5.4	2.2	2.8
6	2.8	3.8	5.7	4.0	7.3	7.8	7.4	5.3	2.1	2.8
7	2.8	3.9	5.7	4.3	7.1	7.6	7.1	5.2	2.5	2.7
8	2.9	4.1	5.7	4.8	6.8	7.1	7.1	5.1	3.0	2.7
9	3.0	4.2	5.6	4.9	7.1	6.4	6.7	5.4	3.2	2.7
10	3.1	3.9	5.6	5.7	7.2	6.2	5.7	5.3	4.0	2.7
11	3.0	3.8	5.5	5.9	7.3	6.3	5.5	5.2	4.7	2.6
12	3.0	3.9	5.1	5.8	6.7	6.2	5.0	5.1	4.1	2.6
13	2.9	3.8	4.5	4.9	6.6	5.4	4.8	5.1	5.0	2.6
14	2.9	3.8	4.6	4.5	6.5	6.5	4.7	4.8	5.2	2.6
15	2.9	3.8	4.5	4.3	6.0	6.9	4.6	4.6	5.1	2.6
16	2.8	3.7	4.4	4.3	5.8	6.3	4.5	4.5	4.8	2.5
17	2.9	3.7	4.4	4.2	5.8	6.6	4.4	4.4	4.4	2.4
18	2.9	3.6	4.3	4.2	5.9	7.0	4.2	4.3	4.8	2.5
19	3.1	3.7	4.5	4.1	5.7	7.1	4.0	4.2	6.8	2.5
20	3.3	3.7	4.6	4.0	5.7	7.2	3.1	4.1	6.6	2.5
21	3.5	3.8	4.7	4.4	5.9	7.1	3.8	3.9	5.5	2.5
22	3.6	3.7	4.6	4.2	6.0	7.0	3.7	3.7	5.2	2.5
23	3.6	3.8	4.5	4.3	6.2	6.1	3.6	3.7	4.8	2.5
24	3.7	3.8	4.5	4.3	7.5	6.9	3.6	3.6	4.3	2.5
25	3.8	3.7	4.1	4.5	7.1	6.8	3.5	3.1	3.8	2.5
26	3.8	5.1	4.4	4.8	8.4	6.0	3.4	3.0	3.7	2.6
27	4.1	5.3	4.5	4.9	7.7	5.8	3.3	2.1	3.6	2.6
28	4.2	5.3	4.4	5.0	7.7	5.6	3.1	2.9	3.5	2.7
29	4.3	.....	4.3	5.9	7.2	5.3	3.0	2.8	3.4	3.6
30	4.3	.....	4.4	8.8	7.6	5.2	5.0	2.7	3.3	2.8
31	4.2	.....	4.3	.....	9.3	.....	7.7	2.6	.....	3.0

NOTE.—River frozen January 1 to February 25, approximately.

Station rating table for Arkansas River at Arkansas City, Kans., from January 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.10	75	3.60	670	5.10	2,190	7.20	5,440
2.20	82	3.70	750	5.20	2,310	7.40	5,800
2.30	90	3.80	840	5.30	2,440	7.60	6,160
2.40	100	3.90	930	5.40	2,570	7.80	6,540
2.50	112	4.00	1,020	5.50	2,700	8.00	6,920
2.60	128	4.10	1,110	5.60	2,840	8.20	7,330
2.70	150	4.20	1,210	5.70	2,980	8.40	7,750
2.80	180	4.30	1,310	5.80	3,120	8.60	8,170
2.90	220	4.40	1,410	5.90	3,270	8.80	8,595
3.00	270	4.50	1,510	6.00	3,420	9.00	9,025
3.10	320	4.60	1,620	6.20	3,730	9.20	9,460
3.20	380	4.70	1,730	6.40	4,050	9.40	9,900
3.30	440	4.80	1,840	6.60	4,380	9.60	10,360
3.40	510	4.90	1,950	6.80	4,720		
3.50	590	5.00	2,070	7.00	5,080		

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905. It is fairly well defined between gage heights 3.3 feet and 8 feet. Above 8 feet this table is the same as table for 1904.

Estimated monthly discharge of Arkansas River at Arkansas City, Kans., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	3,120	1,110	1,996	122,700
April	3,270	1,020	1,702	101,300
May	9,680	2,980	5,422	333,400
June	9,680	2,310	5,000	297,500
July	7,125	270	2,333	143,400
August	6,160	75	1,710	105,100
September	4,720	75	1,272	75,690
October	670	100	173	10,640
The period				1,190,000

NOTE.—No estimate for ice period.

SALT FORK OF ARKANSAS RIVER NEAR ALVA, OKLA.

This station was established September 10, 1903, by W. G. Russell, and was discontinued December 31, 1905 It is located at the railway bridge about one-half mile northeast of Alva, Okla.

The channel is curved for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The bed of the stream is composed of clean sand, and is shifting. There are one or more channels at low water and one at high water, divided by piers and piles.

Discharge measurements are made from the upper side of the deck railway bridge, or by wading at low stages. This bridge is composed of 146 feet of pile approach at the south end, four 80-foot steel girders resting on stone piers, and 652 feet of pile approach at the north end. The initial point for soundings is at the south end.

A standard chain gage is fastened to the upstream guard rail of the bridge; length of chain 23.00 feet. There is also a gage painted on the fourth pier from the south end of the bridge. The sinking of the river bed may cause minus readings at very low water. During

1905 the gage was read once each day by James P. Richmond. The bench mark is the bottom of the coping stone on the north face of the fourth pier from the south end of the bridge; elevation, 8.00 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pages 144–145.

Discharge measurements of Salt Fork of Arkansas River near Alva, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 30	W. G. Russell	82	25	1.16	0.35	29
June 6	J. M. Giles	20	5	.88	.20	4.4
June 21	Earl Patterson	328	190	1.93	1.10	368
July 20	do	22	7	.85	.30	6
August 18	do		37	1.22	.80	45
August 30	J. M. Giles		7.6	1.71	.55	13
September 21	Earl Patterson	40	20	1.29	.50	26
October 19	J. M. Giles	16	5	.64	.25	3
October 27	Earl Patterson	16	5	.52	.20	2
November 25	do		74	1.25	.80	92
December 18	do	37	18	1.09	.45	20

Daily gage height, in feet, of Salt Fork of Arkansas River near Alva, Okla., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.0	0.3	0.4	1.0	1.1	0.4	0.3	0.3	0.4
2		.1	.2	.4	3.3	.8	.3	.3	.4	.4
3		.4	.1	.4	3.0	.5	4.8	.3	.4	.4
4		.3	.1	.3	2.0	.4	2.8	.3	.4	.4
5		.2	.1	.2	1.0	.2	1.6	.3	1.1	.4
6		.1	.1	.2	.5	.0	1.3	.3	.7	.4
7		.1	.1	.2	.3	.6	.8	.3	.5	.4
8		.1	.1	.2	.3	.3	.5	.3	.4	.4
9		.1	1.0	.2	1.0	.3	.3	.3	.4	.4
10		.1	.7	.2	1.5	.3	2.2	.3	.4	.4
11		.1	.4	.2	.8	.3	1.1	.3	.5	.4
12	0.3	.1	.3	.2	.8	.3	.9	.3	.4	.4
13	.3	.1	.2	.2	.5	3.8	.8	.3	.4	.4
14	.3	.1	.1	.2	.3	2.0	.8	.3	.4	.4
15	.3	.1	.1	.2	.3	1.7	.6	.3	.4	.4
16	.4	.1	.1	.2	.1	1.3	.6	.3	.4	.4
17	.5	.1	.1	.2	.0	.9	1.5	.3	.4	.4
18	.9	.1	.1	.1	.0	.4	1.9	.3	.4	.4
19	.5	.1	.1	2.0	.0	.3	1.0	.3	.4	.4
20	.5	.2	.1	1.5	.3	4.8	.8	.3	.4	.4
21	.3	.1	.1	1.5	.3	2.8	.7	.3	.4	.4
22	.2	.1	.1	1.0	.3	1.6	.6	.3	.4	.4
23	.2	.1	.6	.7	.3	1.3	.5	.3	1.7	.4
24	.2	.1	.6	.7	.3	1.0	.4	.3	1.3	.4
25	.2	.1	.6	.6	.3	.9	.4	.4	.8	.4
26	.2	.1	.4	.5	.3	.7	.3	.4	.7	.4
27	.2	.1	.4	.4	.3	.7	.3	.3	.6	.4
28	.1	.4	.4	.3	1.6	.7	.3	.3	.5	.4
29	.0	.3	.4	.2	1.0	.7	.3	.3	.4	.4
30	.0	.35	.4	.2	1.8	.7	.3	.3	.4	.4
31	.0		.4		1.5	.4		.3		.4

SALT FORK OF ARKANSAS RIVER NEAR TONKAWA, OKLA.

This station was established September 18, 1903, by W. G. Russell. It is located at the highway bridge one-half mile south of Tonkawa, Okla.

The channel is straight for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The right bank is low, wooded, and subject to overflow. The left bank is high, wooded, and does not overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at low and high stages, broken only by the pile bents supporting the bridge.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is at the north end of the bridge.

The gage is a staff fastened vertically to the downstream pile of a bent 198 feet from the north end of the bridge. During 1905 the gage was read by T. J. Bird. The bench mark is the top of a nail driven into a 6-inch cottonwood tree about 40 feet east of the north end of the bridge; elevation, 10.50 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 145–147.

Discharge measurements of Salt Fork of Arkansas River near Tonkawa, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 29	W. G. Russell	208	148	0.68	1.35	101
July 28	do	319	546	1.34	2.50	735
August 18	Earl Patterson	48	37	1.22	.80	45
August 30	J. M. Giles	16	8	1.71	.55	13
September 26	W. G. Russell	163	164	.90	1.45	147

Daily gage height, in feet, of Salt Fork of Arkansas River near Tonkawa, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.4	1.5	2.3	1.5	1.3	1.6	1.7	2.1	0.9	1.2
2	1.4	1.5	2.0	2.4	1.2	2.4	2.4	3.2	.9	1.2
3	1.3	1.5	1.9	3.5	1.2	2.4	3.1	2.5	1.0	1.2
4	1.3	1.5	1.8	2.7	1.3	2.0	2.8	2.1	1.8	1.3
5	1.4	.9	1.8	2.0	1.3	1.9	2.9	1.9	1.8	1.3
6	1.4	.9	1.8	1.9	1.3	1.8	2.2	1.8	2.0	1.2
7	1.5	.9	1.9	1.8	1.3	1.9	1.9	1.6	2.4	1.2
8	1.5	.9	1.9	1.7	1.3	1.9	1.9	1.6	5.4	1.2
9	1.5	.9	2.2	1.6	1.4	2.0	1.8	1.4	4.2	1.2
10	1.5	.9	2.5	1.5	1.7	1.9	2.3	1.6	3.8	1.2
11	1.5	.9	2.0	1.5	1.3	1.6	2.6	1.6	3.1	1.2
12	1.5	.9	1.9	1.5	1.1	1.4	1.9	1.6	2.8	1.2
13	1.5	.9	1.8	1.5	1.4	1.4	1.8	2.2	2.8	1.2
14	1.5	.9	1.9	1.5	1.8	1.3	1.8	7.8	2.7	1.2
15	1.5	.9	1.9	1.5	1.6	1.3	1.6	5.8	2.4	1.2
16	1.5	.9	1.8	1.5	1.3	1.3	1.5	4.5	2.0	1.2
17	1.5	.9	1.9	1.5	1.3	1.3	1.4	3.9	1.7	1.2
18	1.5	.9	2.2	1.6	1.3	1.2	1.3	3.0	1.7	1.2
19	1.5	.9	2.8	1.5	1.3	1.2	1.2	2.3	1.7	1.2
20	1.5	1.2	1.8	1.5	1.3	1.2	1.2	2.6	1.5	1.2
21	1.5	1.6	1.5	1.4	1.3	1.2	1.6	2.6	1.6	1.2
22	1.5	2.1	1.7	1.3	1.3	3.9	1.3	2.6	1.5	1.3
23	1.5	2.6	2.0	1.2	1.3	2.9	3.0	2.9	1.4	1.2
24	1.5	2.8	1.9	1.2	1.3	2.8	4.0	3.0	1.2	1.2
25	1.5	2.6	1.8	1.3	1.3	2.6	4.3	2.6	1.0	1.2
26	1.5	2.6	1.6	1.3	1.3	1.2	3.0	2.0	1.0	1.2
27	1.5	2.4	1.6	1.3	2.8	1.9	2.8	1.9	1.2	1.2
28	1.5	2.3	1.6	1.2	2.6	1.6	2.5	1.8	1.2	1.3
29	1.5	.....	1.5	1.2	2.6	1.5	2.0	1.6	1.2	1.2
30	1.5	.....	1.5	1.3	2.6	1.7	1.9	1.0	1.2	1.3
31	1.5	.....	1.5	.....	2.4	.....	1.9	1.0	.....	1.4

PURGATORY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Purgatory River, a characteristic stream of eastern Colorado, is the principal tributary of Arkansas River in Colorado. It rises in the Culebra Mountains and flows northeastward across the plains for a distance of 165 miles. In the spring the channel carries a moderate volume of water, but as summer approaches this is greatly diminished by irrigation and natural conditions until the channel is practically dry. The volume of water contributed to the Arkansas is so small that it has no appreciable effect on the discharge of that river save at times of excessive rainfall, when it may discharge a large volume for a short time.

The drainage basin of Purgatory River is long and narrow. The total area is 3,386 square miles, of which 742 square miles, lying above Trinidad, are mountainous, the country being made up of shales, sandstones, and igneous rocks. This area is much broken by numerous stream channels, which are normally dry. The lower basin is largely foothill country, merging into rough plains farther east. Drainage lines are well defined throughout this area. For 60 miles of its length, commencing 25 miles below Trinidad, Purgatory River flows in a deep canyon. There are numerous small tributary canyons at various angles to the main channel. The soil of this lower basin is largely detritus from decomposed shales, sandstones, and similar soft sedimentary rocks. Erosion is still vigorous, and after a storm the flood waters often contain in suspension as much as 10 per cent (by volume) of silt.

In the mountainous portion the Weather Bureau records at Clearview for fifteen years give a mean annual rainfall of 23 inches; at Trinidad, ten years' record, 17 inches. The plains drainage has approximately a mean annual precipitation of 12 inches.

A characteristic feature of this stream is the occurrence of sudden and disastrous floods, which take place irregularly and are the run-off of excessive precipitation. In the spring periodic floods occur from melting snow, which is often supplemented by spring rains. During these floods large areas of the stream bank are eroded. The most disastrous flood on record occurred October 1, 1904.

No storage is practiced on this stream, though investigations are being made by a corporation with the purpose of constructing a large storage reservoir for use in irrigation.

No power has been developed, and because of the abundance of coal in the vicinity of Trinidad it is doubtful if power development would be feasible, even under very favorable circumstances.

PURGATORY RIVER AT TRINIDAD, COLO.

This station was established May 1, 1896, at the Animas Street Bridge, the gage rod being attached to the cylindrical pier at the west end of the bridge. The station was, however, discontinued July 31, 1899, the greater portion of the water in the river being diverted above the gaging station; the channel was also shifting and results not satisfactory. July 25, 1905, the Trinidad station was reestablished, at the old location on the Animas Street Bridge, by R. I. Meeker. The reestablishment was for the purpose of collecting general hydrographic data, especially flood data.

The river channel is irregular in course at low water, but is generally straight above the bridge for a distance of a few hundred feet. Below, the channel is straight for a distance of 100 feet. The stream bed is composed of a loose deposit of cobblestones, graduating into coarse gravel and sand, and is more or less shifting. The left bank is a loose riprap of stone above the bridge, with piling below. The right bank consists of the riprap embankments of the Colorado and Southern Railway, and will overflow at extreme high water. There is usually but one channel at all stages. Velocity at low stages is sluggish, increasing to swift velocities during high stages.

Discharge measurements are made from the downstream footway. A standard chain gage is attached to the upstream footway of the bridge; length of chain, 22.52 feet. The gage scale reads from 0 to 10 feet, the chain having two markers, giving a range of 20 feet in gage heights. During 1905 the gage was read twice each day by Perry Foote. The bench mark is a cross cut within a circle on the porch of the house at No. 312 Nevada Avenue, about 300 feet north of the Animas Street Bridge; elevation, 14.99 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; WS=Water-Supply Papers):

Description: Ann 18, iv, pp 231-232; WS 16, p 123; 28, p 108; 37, p, 263.
Discharge: Ann 18, iv, p 232; WS 16, p 123; 28, p 116; 37 p 263.
Discharge, monthly: Ann 19, iv, p 359; 20, iv, pp 329, 341; 21, iv, p 235.
Discharge, yearly: Ann 20, iv, p 57.
Gage heights: WS 11, p 61; 16, p 123; 28, p 113; 37, p 263.
Hydrograph: Ann 19, iv, p 360; 20, iv, p 341; 21, iv, p 236.
Rainfall and run-off relation: Ann 20, iv, p 330.
Rating tables: Ann 19, iv, p 358; WS 28, p 117; 39, p 450.

Discharge measurements of Purgatory River at Trinidad, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 25	R. I. Meeker	45	62	2.29	.....	142
August 25	do	43	126	2.83	5.65	357
August 26	do	35	73	1.97	5.10	144
November 4	do	25	18	1.22	4.67	22

Daily gage height, in feet, of Purgatory River at Trinidad, Colo., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.05	4.52	4.65	5.0	17		4.55	4.65	4.7	5.0
2		4.75	4.58	4.75	5.0	18		4.62	4.6	4.7	5.2
3		4.7	4.6	4.72	5.0	19		4.68	4.55	4.7	5.2
4		5.35	4.55	4.7	4.9	20		4.65	4.6	4.7	5.0
5		4.7	4.58	4.7	4.9	21		4.6	4.58	4.7	5.0
6		5.0	4.6	4.7	4.9	22		4.6	4.55	4.85	5.1
7		5.1	4.52	4.65	4.9	23		4.58	4.58	4.85	5.2
8		4.88	4.5	4.52	4.95	24		4.5	4.68	4.7	5.2
9		4.95	4.6	4.72	5.0	25		4.58	4.6	4.7	5.2
10		4.92	4.52	4.7	5.0	26	5.05	4.6	4.62	4.7	5.2
11		4.78	4.68	4.7	5.0	27	4.9	4.7	4.6	4.7	5.2
12		4.72	4.6	4.7	5.0	28	4.95	4.7	4.65	4.9	5.2
13		4.68	4.6	4.7	4.88	29	4.8	4.55	4.65	4.7	5.2
14		4.62	4.6	4.7	4.88	30	4.85	4.58	4.65	4.7	5.2
15		4.6	4.6	4.7	5.0	31	4.8		4.65		5.2
16		4.58	4.58	4.7	5.3						

Station rating table for Purgatory River at Trinidad, Colo., from August 27 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.50	11	4.90	81	5.30	215	5.70	375
4.60	17	5.00	111	5.40	253	5.80	421
4.70	31	5.10	144	5.50	293	5.90	468
4.80	55	5.20	179	5.60	333		

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905. It is fairly well defined.

Estimated monthly discharge of Purgatory River at Trinidad, Colo., for 1905.

[Drainage area, 742 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
August 26-31	128	55	80.5	958	0.108	0.024
September	234	11	47.3	2,815	.064	.071
October	28	11	17.7	1,088	.024	.028
November	68	12	34.8	2,071	.047	.052
December	215	76	133	8,178	.179	.206
The period				15,110		

PURGATORY RIVER NEAR ALFALFA, COLO.

This station was established March 23, 1905, by R. I. Meeker. It is located one-eighth of a mile below the canyon entrance, 4 miles east of Alfalfa post-office, and about 25 miles east of Trinidad, in T. 33 S., R. 60 W.

The channel is straight for 200 feet above and below the cable, and is composed primarily of large fragments of sandstone; on top of these and along the sides of the channel is a

shifting bed of sand, which is deposited at low water and reaches a depth of at least 2 feet; above gage height 7 feet this deposit is usually scoured out. The current of Purgatory River is very swift and beds of sand are rapidly deposited and scoured out during a year's time. The right bank, which is the canyon side, is a talus slope composed largely of fragments of sandstone from the vertical wall above, the interstices and intervening stretches being filled by a deposit of sand. The left bank is of sand, about 8 feet high, gradually sloping into the talus above. Above the talus slopes on either side the canyon walls are vertical for 75 feet. Except at very low water there is more or less boiling of the current, which interferes during measurements. At high water the velocity is swift.

Discharge measurements are made by means of a cable, car, stay wire, and tagged wire. The initial point for soundings is the zero mark of the tagged line at the right bank, near the face of the large bowlder to which the cable is anchored. At low water, discharge measurements are often made by wading.

The permanent gage is an inclined staff bolted to a large sandstone bowlder on the right bank of the stream, 15 feet below the cable. From 10 to 20 feet the gage consists of a vertical staff bolted to an immense bowlder to which the righthand end of the cable is anchored. After the high water of 1905 the channel filled in with sand so that the little water that was in the river flowed along the left bank. August 7 a temporary rod was established on the left bank at the same datum as the permanent gage. This rod is a staff driven vertically into the river bed at left bank. During 1905 the gage was read once each day during ordinary and twice or more during varying stages, by Leigh Bull. The bench mark is a dash cut in the bowlder to which the vertical portion of the original rod is attached; elevation, 10.00 feet above the datum of the gage.

Discharge measurements of Purgatory River near Alfalfa, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 24	R. I. Meeker	83	90	2.51	4.85	226
March 28	L. D. Bull	83	100	1.80	4.40	180
April 17	do	83	130	2.46	5.20	320
April 25	do	85	328	3.86	7.35	1,265
May 4	do	95	194	3.78	6.35	734
May 17	do	85	100	3.68	5.10	368
May 21	do	90	140	4.04	6.05	565
May 29	do	90	120	3.25	5.25	393
June 11	do	90	110	3.65	5.50	402
July 23	do	90	150	4.35	6.28	653
August 3	do	96	110	4.34	5.80	478
August 7	R. I. Meeker	37	53	2.74	4.00	145
August 8	L. D. Bull	36	47	2.55	3.80	120
August 12	do	43	56	2.62	4.00	147
August 19	do	30	11.3	.85	2.65	9.6
August 25	do	94	170	5.08	6.80	866
September 2	do	75	52	1.86	3.88	97
September 8	do	68	46	1.89	3.55	87
September 21	do	28	8.7	.78	2.60	6.8
October 11	do	28	7.2	.53	2.55	3.8
November 26	do	22	6	.83	2.55	5
December 3	do	26	15	1.07	2.80	16
December 14	do	26	24	.88	3.20	21

Daily gage height, in feet, of Purgatory River near Alfalfa, Colo., for 1905.

Day.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.2	7.5	5.5	2.75	4.0	3.95	2.65	2.45	2.8
2	.....	5.66	7.3	5.4	2.6	5.0	3.9	2.65	2.45	2.8
3	.....	5.45	6.8	5.3	2.5	6.1	3.7	2.6	2.45	2.8
4	.....	6.24	6.4	5.3	2.4	3.8	3.35	2.6	2.45	2.8
5	.....	5.9	5.85	5.75	2.3	3.9	3.5	2.6	2.45	2.8
6	.....	6.6	5.4	5.6	2.2	3.9	5.1	2.6	2.45	2.75
7	.....	6.6	5.25	5.5	2.1	3.9	4.2	2.55	2.4	2.75
8	.....	6.45	5.3	6.0	2.15	3.8	3.8	2.55	2.45	3.1
9	.....	6.55	5.1	5.8	2.0	3.7	3.35	2.55	2.45	3.2
10	.....	6.3	5.6	5.4	1.9	3.65	3.15	2.55	2.45	3.0
11	.....	6.0	5.2	5.5	1.95	3.5	3.05	2.55	2.45	3.0
12	.....	5.8	4.85	5.4	1.9	4.0	2.9	2.55	2.45	3.0
13	.....	5.55	4.8	5.3	1.8	3.85	2.7	2.55	2.45	3.2
14	.....	5.55	5.1	5.1	1.7	3.55	2.7	2.55	2.45	3.2
15	.....	5.6	5.1	4.9	1.6	3.4	2.65	2.55	2.45	3.2
16	.....	5.5	5.1	4.7	1.5	3.3	2.65	2.55	2.45	3.1
17	.....	5.2	5.2	4.6	1.55	3.0	2.6	2.55	2.45	3.15
18	.....	5.2	5.25	4.25	1.6	2.8	3.75	2.55	2.45	3.1
19	.....	5.35	5.2	4.1	1.65	2.65	2.75	2.55	2.45	3.1
20	.....	5.5	5.8	4.0	1.65	2.55	2.65	2.55	2.45	3.1
21	.....	5.0	6.1	3.9	1.7	2.5	2.65	2.55	2.4	3.05
22	5.8	4.8	5.9	3.9	6.2	2.45	2.6	2.55	2.4	3.05
23	5.25	4.9	9.0	3.85	4.8	2.4	2.6	2.55	3.4	3.1
24	5.1	8.08	5.9	3.75	4.0	2.35	2.6	3.1	3.1	.....
25	4.7	7.96	5.6	3.7	3.1	12.9	2.6	2.8	3.0	.....
26	4.5	9.72	5.45	3.6	3.2	5.5	3.8	2.65	2.7	.....
27	4.45	11.01	5.4	3.4	2.9	4.2	3.1	2.55	2.5	.....
28	4.4	10.35	5.3	3.15	2.6	4.0	2.9	2.5	2.5	.....
29	4.15	8.6	5.25	2.95	2.4	3.8	2.8	2.5	2.5	.....
30	4.0	7.7	5.25	2.85	3.2	4.5	2.75	2.45	2.8	.....
31	3.8	.....	5.3	.....	5.3	4.0	.....	2.45	.....	3.2

Station rating table for Purgatory River near Alfalfa, Colo., from March 22 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	0	3.10	37	4.70	228	7.60	1,250
1.60	1	3.20	45	4.80	244	7.80	1,360
1.70	1	3.30	53	4.90	261	8.00	1,480
1.80	1	3.40	62	5.00	280	8.20	1,600
1.90	2	3.50	72	5.20	322	8.40	1,730
2.00	2	3.60	82	5.40	369	8.60	1,860
2.10	3	3.70	93	5.60	421	8.80	2,000
2.20	4	3.80	105	5.80	479	9.00	2,140
2.30	5	3.90	117	6.00	545	9.50	2,505
2.40	6	4.00	130	6.20	618	10.00	2,900
2.50	8	4.10	143	6.40	695	10.50	3,330
2.60	11	4.20	156	6.60	778	11.00	3,780
2.70	15	4.30	170	6.80	865	11.50	4,250
2.80	19	4.40	184	7.00	955	12.00	4,730
2.90	24	4.50	198	7.20	1,045	12.50	5,230
3.00	30	4.60	213	7.40	1,145		

The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1905. It is well defined between gage heights 2.5 feet and 7 feet. Below 2.5 feet the table is very uncertain.

Estimated monthly discharge of Purgatory River near Alfalfa, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 22 to 31	479	105	230	4,562
April	3,789	244	911	54,210
May	2,140	244	502	30,870
June	545	22	248	14,760
July	618	0	50.9	3,130
August	5,630	6	29.3	18,020
September	300	11	54.6	3,249
October	37	7	11.3	695
November	62	6	11.3	672
December 1-23, 31	45	17	32.3	1,538
The period				131,700

CIMARRON RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Cimarron River rises in the Raton Mountain Range in Colfax County, N. Mex., at an elevation of nearly 7,000 feet, and flows eastward across Beaver County, in Oklahoma, then across the southwest corner of Kansas, entering Oklahoma again in Woodward County, and following a southeasterly course to its junction with Arkansas River at the Indian Territory line. The basin lies between those of Arkansas and North Canadian rivers, and is within the arid belt. From west to east it is 190 miles from the source to the gaging station at Arkalon, Kans., and 450 miles to its mouth, its extreme width is not more than 50 miles. The area of the basin is 5,200 square miles. The elevation at Arkalon is 2,615 feet; most of the difference of elevation from the source of the river occurs in New Mexico.

The upper course of the Cimarron is entirely in a mountainous and hilly region, very precipitous, rocky, and impervious. In this portion there are no tributaries of any size, and the river seldom receives much water from melting snows. As it approaches Kansas the bottoms are sandy and porous, and, while the adjacent land is hilly, the soil is generally a black loam covered with buffalo grass. There is considerable timber along all the streams in New Mexico and northwestern Oklahoma, but very little in Kansas. The rainfall is very light, being about 12 inches in New Mexico and Oklahoma and increasing to 20 inches at Arkalon. Floods are rare and have no regular periods of occurrence. There are no lakes or marshes in this drainage basin, except small areas here and there along the river bottoms. The land is but little cultivated, forage being the principal product. There are few springs along Cimarron River below the Kansas line and underground water is at depths of from 50 to 150 feet. Some irrigation is practiced by private parties in New Mexico and Oklahoma, but none in Kansas. There is no water for power development in this basin.

CIMARRON RIVER NEAR KENTON, OKLA.

This station was established April 5, 1904, by W. G. Russell, and was discontinued July 31, 1905. It was located at the highway crossing on the main road, one-half mile north of Kenton, Okla.

The channel is very narrow and crooked, and the current is sluggish. Both banks are low, wooded, and subject to overflow. The bed of the stream is muddy, but too narrow to shift much. There is only one channel at low or medium stages, but there may be two at high stages.

Discharge measurements are made at low water by wading near the gage. At high stages discharges must be computed from the cross section and slope. The initial point for soundings is on the right bank of the stream.

There are two gages. The first is a staff driven vertically into the bed of the stream and fastened to posts driven into the ground. The second gage is in two sections, the first being the same as gage No. 1 and located 70 feet southwest of it. The second section is fastened to a cedar post 100 feet east of the first gage. During 1905 the gage was read by L. A. Wikoff. The bench mark is the top of three nails driven into the west side of an 18-inch willow tree standing 100 feet southwest of the first gage; elevation 8.15 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 147-148, 181.

Discharge measurements of Cimarron River near Kenton, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 10	J. M. Giles	18	52	0.95	1.10	49
June 11	do	18	46	.59	.80	27
June 11	do	18	47	.65	.90	31
June 12	do	18	45	.53	.70	24

Daily gage height, in feet, of Cimarron River near Kenton, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	0.8	0.8	0.9	2.4	1.4	0.9	2.6
2	.9	.8	.8	1.9	1.2	1.5	.3
3	.9	.8	.8	1.1	1.0	.9	.2
4	.9	.8	.8	1.0	.9	.7	.1
5	.9	.8	.8	.8	.8	.4	.0
6	.9	.8	.9	.8	.8	.4	.0
7	.9	.8	.9	.8	.8	.5	.0
8	.9	.8	.9	.8	.7	4.5	.1
9	.8	.8	.7	1.4	.7	1.1	.1
10	.8	.8	.7	1.6	.7	1.1	.1
11	.8	.8	.7	1.4	.7	.8	.1
12	.9	.8	.7	1.1	.7	.7	.1
13	.9	.8	.7	1.0	.7	.7	.1
14	.9	.8	.7	.9	.6	.7	.0
15	.9	.8	.7	.9	.6	.7	.1
16	.8	.8	.8	.8	.6	.6	.1
17	.9	.8	.8	.8	.5	.5	.0
18	.9	.5	.7	.8	.7	.5	.0
19	.9	.6	.7	.8	.5	.5	.0
20	1.0	.8	.7	.8	.5	.4	.0
21	.9	.8	.7	.8	2.1	.4	.0
22	.9	.8	.7	.8	.9	.3	2.6
23	.8	.8	.7	1.6	4.8	.2	1.1
23	.8	.8	.7	5.8	1.1	.2	.3
25	.8	.8	.7	4.8	1.1	.1	.1
26	.9	.7	.7	1.4	2.9	.1	.0
27	.9	.9	.7	3.4	4.3	.0	.0
28	.8	.9	.7	3.5	2.3	.0	.4
29	.8	.....	.7	2.3	1.4	.0	.0
30	.8	.....	.7	1.7	.....	.1	.0
31	.8	.....	.7	.....	.9	.....	.0

CIMARRON RIVER NEAR GARRETT, OKLA.

This station was established May 8, 1905. It is located at Strong's ranch, about 3 miles west of Garrett, Okla., 20 miles east of Kenton, and 50 miles by stage from Clayton, N. Mex., the nearest railroad station. The station is below the mouth of North Carriso and South Carriso creeks and 1 mile below the site of the proposed dam for a storage reservoir.

The channel is straight for 100 feet above and 300 feet below the gage. The current is swift. Both banks are about 6 feet high and subject to overflow. The bed of the stream is composed of rocks and is permanent. There is but one channel at all stages.

Discharge measurements are made by wading near the gage at low water and from a cable one-half mile below the gage at high water. The initial point for soundings is the post supporting the cable on the right bank.

A vertical staff gage is fastened to a cottonwood tree on the left bank, about one-half mile east of the ranch house. During 1905 the gage was read once each day by R. L. Strong. Bench marks were established as follows: (1) A nail in a cross cut in a sandstone ledge at the foot of the hill south of the river, about 50 feet upstream from the gage; elevation, 16.30 feet. (2) A nail in the root of a cottonwood tree about 25 feet north of the gage; elevation, 7.12 feet. Elevations refer to the datum of the gage.

Discharge measurements of Cimarron River near Garrett, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 7	W. W. Schlecht	24	41	1.00	1.30	41
June 12	J. M. Giles	24	28	2.39	1.52	68
June 12	do	24	32	2.08	1.50	67
June 13	do	23	34	1.58	1.40	53
June 13	do	23	33	1.59	1.40	52
June 14	do	24	40	1.98	1.69	80
June 14	do	24	42	2.17	1.79	91
August 17	do	14	12.5	1.80	.90	22
August 18	do	14	12	1.38	.80	17
September 26	E. Patterson		8	1.46	.75	11.7
September 27	do		8.5	1.15	.73	10.7
September 28	do		8.1	1.20	.71	9.7
November 14	do		11	1.47	.85	16
([a])	J. M. Giles		8.1	3.68	3.50	298
([a])	do		19.7	5.49	6.50	1,082

[a] Computed from slope measurement, using Kutter's formula.

Daily gage height, in feet, of Cimarron River near Garrett, Okla., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.55	0.8	0.6	0.55	0.6	0.8	0.9
2		2.65	2.25	6.1	.55	.65	.8	.9
3		1.6	.95	4.3	.5	.65	.85	.9
4		1.45	.8	1.8	1.1	.65	.9	.85
5		1.25	.8	1.4	.75	.65	.8	.85
6		1.2	.75	.95	2.5	.65	.8	.85
7	1.3	1.15	.75	6.5	1.55	.65	.8	.85
8	1.3	9.3	1.95	4.55	3.95	.65	.85	.85
9	1.2	2.8	1.0	1.55	4.6	.65	.85	.85
10	1.15	2.1	.8	1.2	5.3	.65	.85	.85
11	1.1	1.8	.7	.95	2.0	.65	.85	.65
12	1.1	1.5	.65	1.0	1.3	.65	85	.65
13	1.05	1.4	.65	3.3	1.0	.7	.85	.65
14	1.05	1.5	.65	1.4	.9	.7	.85	.65
15	1.1	1.35	.6	1.1	.9	.7	.85	.65
16	1.1	1.15	.8	1.0	.85	.7	.85	.7
17	1.1	1.2	.8	.9	.85	.7	.85	.85
18	1.05	1.1	.6	.85	.85	.7	.85	.9
19	1.0	1.05	.55	.8	.85	.7	.85	.9
20	1.0	1.0	.5	.8	.8	.75	.85	.9
21	1.05	1.0	.55	.95	.8	.75	.85	.9
22	4.45	.9	.7	.75	.75	.75	.95	.85
23	10.35	.9	2.0	.7	.75	.75	1.5	.85
24	3.4	.85	1.0	.65	.75	.75	1.3	.8
25	1.95	.85	.85	.6	.7	.8	1.0	.8
26	2.55	.8	.8	.6	.8	.8	1.0	.85
27	7.8	.8	.65	.6	.7	.8	.95	.9
28	3.42	.8	1.0	.55	.7	.8	.9	.9
29	2.55	.8	.9	.55	.65	.8	.9	.9
30	1.75	1 1	.7	.55	.65	.8	.9	.85
31	1.6		.65	.55		.8		.85

Station rating table for Cimarron River near Garrett, Okla., from May 7 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	10	1.80	87	2.90	205	4.00	385
0.80	14	1.90	96	3.00	220	4.20	422
0.90	19	2.00	105	3.10	235	4.40	461
1.00	25	2.10	114	3.20	251	4.60	503
1.10	31	2.20	124	3.30	267	4.80	548
1.20	38	2.30	134	3.40	283	5.00	595
1.30	46	2.40	144	3.50	299	5.20	646
1.40	54	2.50	155	3.60	316	5.40	701
1.50	62	2.60	166	3.70	333	5.60	760
1.60	70	2.70	178	3.80	350	5.80	823
1.70	78	2.80	191	3.90	367	6.00	890

The above table is applicable only for open-channel conditions. It is based on fifteen discharge measurements made during 1905. It is well defined between gage heights 0.7 foot and 1.8 feet. Above 1.8 feet the table is based on computations from two slope measurements, using Kutter's formula. This extension can be considered only roughly approximate.

Estimated monthly discharge of Cimarron River near Garrett, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May (23 days)	.....	25	91.0	4,152
June (29 days)	.....	14	49.6	2,853
July	129	5	22.2	1,365
August (30 days)	.....	6	90.5	5,385
September	673	5	74.4	4,427
October	14	7	10.4	640
November	62	14	19.5	1,160
December	19	8	15.4	947
The period	.....	.....	.....	20,930

NOTE.—On the days missing the discharge was above the limit of the rating table.

CIMARRON RIVER AT ARKALON, KANS.

This station was established August 15, 1903, by W. G. Russell, and was discontinued October 31, 1905. It is located at the Chicago, Rock Island and Pacific Railway bridge, about one-half mile north of Arkalon, Kans.

The channel is straight for about 100 feet above and below the station. The current is sluggish at low and swift at high stages. Both banks are low and liable to overflow. The railroad embankment is high at each end of the bridge, forcing the water to pass beneath the bridge at all stages. There is but one channel, which is shallow except at high water. The piles of the bridge and drift may at times affect the measurements.

Discharge measurements are made from the bridge, but can be made at low water by wading. The initial point for soundings is the end of the bridge at the right bank of the river.

The original gage is a staff fastened to the fifth pile bent from the south end of the bridge, on the downstream side. Sand having collected at the foot of the gage April 17, 1905, a section reading from zero to 2 feet was fastened to the fourth bent on the downstream side. During 1905 the gage was read once each day by Miss Ethel Singer. Bench marks were

established as follows: (1) The top of the cap at the east end of the second bent from the south end of the bridge; elevation, 15.76 feet. (2) The top of two nails in the top of a pile about 5 feet from the southwest corner of the bridge, 6.5 feet from the west side of the rail; elevation, 17.22 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Papers):

Description: Ann 18, iv, p 243; Bull 140, p 167; WS 99, p 247; 131, pp 148-149.
Discharge: Ann 18, iv, p 243; Bull 140, p 167; WS 99, p 247; 131, p 149.
Discharge, monthly: Ann 18, iv, p 244; Bull 140, p 167.
Gage heights: Bull 140, p 167; WS 11, p 64; 99, p 227; 131, p 149
Rating table: Ann 18, iv, p 244.

Discharge measurements of Cimarron River at Arkalon, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	W. G. Russell	39	25	1.40	1.60	35
August 2	do	28	16	1.37	1.30	22

Daily gage height, in feet, of Cimarron River at Arkalon, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.3	1.6	1.3	1.7	1.9	4.0	1.4	1.5	1.3	1.3
2	1.3	1.7	1.3	1.5	1.9	3.8	1.4	1.3	1.3	1.3
3	1.3	1.8	1.3	1.9	1.9	3.0	1.4	1.3	1.3	1.3
4	1.3	1.9	1.3	1.9	1.9	2.6	1.4	1.3	1.5	1.3
5	1.3	1.9	1.4	1.9	1.9	2.0	1.4	1.3	1.4	1.3
6	1.3	1.9	1.4	1.9	1.9	1.6	1.4	1.3	1.3	1.3
7	1.3	1.9	1.4	1.8	1.9	1.4	1.4	1.3	1.3	1.3
8	1.3	1.9	1.4	1.8	1.9	1.4	1.4	1.3	1.3	1.3
9	1.3	1.9	1.4	1.8	1.8	1.4	1.4	2.5	1.3	1.3
10	1.3	1.9	1.4	1.8	1.8	4.6	1.4	2.7	1.6	1.3
11	1.3	1.9	1.4	2.0	1.8	2.9	1.4	2.3	1.4	1.3
12	1.3	1.9	1.4	1.8	1.8	2.6	1.4	1.7	1.3	1.3
13	1.3	1.9	1.4	1.8	1.8	2.3	1.4	1.3	1.7	1.3
14	1.3	1.2	1.4	1.7	1.8	2.0	1.4	1.3	1.4	1.3
15	1.3	1.2	1.4	1.6	1.7	1.9	1.4	1.3	1.3	1.3
16	1.3	1.3	1.4	1.5	1.7	1.6	1.4	1.3	1.7	1.3
17	1.3	1.3	1.4	1.6	1.5	1.4	1.4	1.3	1.4	1.3
18	1.3	1.3	1.4	1.6	1.4	1.4	1.5	1.3	1.3	1.3
19	1.3	1.3	1.4	1.5	1.4	1.4	1.5	1.3	1.3	1.3
20	1.3	1.3	1.4	1.5	1.4	1.4	1.4	1.3	1.3	1.3
21	1.3	1.6	1.4	1.5	1.4	1.4	1.4	1.3	1.3	1.3
22	1.3	2.1	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3
23	1.3	1.9	1.4	1.8	1.4	1.4	1.4	1.3	1.3	1.3
24	1.3	1.7	1.4	2.5	3.7	1.4	1.4	1.3	1.3	1.3
25	1.3	1.4	1.4	2.8	3.8	1.4	1.4	1.3	1.3	1.3
26	1.3	1.4	1.4	3.4	3.5	1.4	1.4	1.3	1.3	1.3
27	1.3	1.3	1.4	4.6	3.4	1.4	1.4	1.3	1.3	1.3
28	1.3	1.3	1.4	3.0	3.6	1.4	1.4	1.3	1.3	1.3
29	1.3	.....	1.4	1.9	4.2	1.4	1.4	1.3	1.3	1.3
30	1.4	.....	1.4	1.9	4.7	1.4	1.5	1.3	1.3	1.3
31	1.5	.....	1.4	.....	4.5	.....	1.5	1.3	.....	1.3

CIMARRON RIVER NEAR WAYNOKA, OKLA.

This station was established September 11, 1903, by W. G. Russell, and was discontinued December 31, 1905. It is located at the railway bridge 2½ miles southwest of Waynoka, Okla.

The channel is straight for 1,000 feet above and below the station. Both banks are liable to overflow at very high water. The bed is shifting quicksand. At low water there may be several channels. At high water there is one channel, broken by the bridge supports.

Discharge measurements are made from the railway bridge, which is supported on piles and has a total span of 2,158 feet, and by wading at low water. The initial point for soundings is the east end of the bridge.

The gage is a staff fastened to the east side of the eighth pile bent from the east end of the bridge. During 1905 the gage was read by M. J. Sunden. Bench marks were established as follows: (1) The top of the cap of the bench to which the gage is spiked; elevation 10.93 feet. (2) The northeast corner of the cap of the bent at the fill at the east end of the bridge on the downstream side; elevation, 10.09 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 246; 131, p 150.
Discharge: 131, p 150.
Gage heights: 99, p 246; 131, p 151.

Discharge measurements of Cimarron River near Waynoka, Okla., in 1905.

Date.	Hydrographer.	Gage. height.	Dis-charge.
		Feet.	*Second-feet.*
May 1	W. G. Russell	1.90	905
June 7	J. M. Giles	.90	68
June 20	Earl Patterson	.95	99
June 21	do	1.40	318
July 20	do	.40	.2
August 18	do	1.10	93
August 28	do	.30	2.6
September 20	do	.90	40
October 21	J. M. Giles	.30	.2
October 26	Earl Patterson	.41	.4
November 26	do	1.50	258
December 19	do	1.05	75

Daily gage height, in feet, of Cimarron River near Waynoka, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.3	1.5	1.0	1.9	1.6	0.8	1.6	0.3	0.5	0.5	1.0
2	1.1	1.3	1.4	1.0	1.8	1.5	2.4	1.5	.3	.5	.5	1.0
3	1.2	1.3	1.4	1.0	1.7	1.5	3.0	1.0	.3	.5	.5	1.0
4	1.2	1.3	1.3	1.0	1.6	1.3	3.0	.8	.3	.5	.5	1.0
5	1.2	1.3	1.3	1.5	1.5	1.0	2.0	.6	.3	.5	.6	1.0
6	1.2	1.3	1.3	1.5	1.5	.9	1.8	.5	.3	.5	.6	1.0
7	1.2	1.3	1.3	1.5	1.5	.8	1.6	.5	.3	.5	1.0	1.0
8	1.1	1.3	1.3	1.5	1.5	.8	1.3	.5	.6	.4	1.0	1.0
9	1.1	1.3	2.0	1.5	1.4	.7	2.0	.5	.6	.4	1.0	1.0
10	1.1	1.3	2.0	1.5	1.3	.7	1.8	.5	4.5	.4	1.0	1.0
11	1.0	1.3	2.0	1.4	1.2	.6	1.5	.5	2.5	.4	1.0	1.0
12	1.0	1.3	2.0	1.4	1.1	.5	1.2	.5	2.0	.4	1.0	1.0
13	1.0	1.3	2.0	1.3	1.0	.5	1.0	2.4	1.8	.4	1.0	1.0
14	1.0	1.3	2.0	1.3	1.0	.6	.8	2.0	1.5	.4	1.0	1.0
15	1.0	1.3	2.0	1.3	1.0	.7	.5	1.9	1.3	.4	.9	1.0
16	1.0	1.3	2.0	1.3	1.0	1.0	.3	1.5	1.0	.4	.9	1.0
17	1.0	1.3	2.0	1.3	1.0	1.0	.4	1.2	1.0	.4	.9	1.0
18	1.0	1.3	2.0	1.3	1.0	1.0	.4	1.0	1.0	.3	.9	1.0
19	1.1	1.3	2.0	1.6	1.0	1.0	.4	1.0	.9	.3	.9	1.0
20	1.2	1.3	1.8	1.6	1.0	1.0	.4	1.5	.8	.3	1.0	1.0
21	1.3	1.3	1.6	1.5	1.0	1.2	.4	1.3	.7	.3	1.0	1.0
22	1.3	1.4	1.5	1.5	1.0	1.3	2.3	1.2	.6	.3	1.0	1.0
23	1.3	1.5	1.5	1.5	1.0	1.4	2.0	1.0	.6	.3	1.0	1.0
24	1.3	1.9	1.4	1.5	1.0	1.5	1.8	.8	.6	.4	2.0	1.0
25	1.3	1.9	1.4	2.2	1.0	1.0	1.6	.6	.6	.4	1.2	1.0
26	1.3	1.6	1.4	2.2	2.0	1.4	1.5	.5	.6	.4	1.2	1.0
27	1.3	1.5	1.3	2.2	2.0	1.3	1.4	.5	.6	.4	1.2	1.0
28	1.3	1.5	1.2	2.0	2.0	1.2	2.5	.5	.6	.4	1.2	1.0
29	1.3	.....	1.1	2.0	2.0	1.0	2.0	.5	.6	.4	1.1	1.0
30	1.3	.....	1.0	1.9	2.0	.9	2.0	.4	.6	.4	1.1	1.0
31	1.3	.....	1.0	.....	1.8	.....	1.8	.4	.....	.4	.....	1.0

VERDIGRIS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

This drainage basin lies between those of Grand and Arkansas rivers, being entirely within the humid belt. It has no mountain tributaries, but depends for its water supply on the precipitation within its area. Its catchment area extends east and west in Kansas and Indian Territory a distance of 70 miles, and north and south 170 miles, giving it an area of 7,920 square miles at the gaging station at Catoosa, Ind. T. The main stream is formed by springs and small tributaries in Chase County, Kans., about 100 miles east of the center of the State, at an elevation of 1,075 feet, and flows nearly due south into Arkansas River just above its junction with Grand River, about 6 miles northeast of Muscogee. Its elevation at the mouth is 513 feet above sea level. Its principal tributaries are Fall, Elk, and Caney rivers, all of which enter from the west. Fall and Elk rivers drain southern Kansas, and Caney River drains southern Kansas and part of Indian Territory.

This basin lies within the Coal Measures and is composed of porous and broken sandstones and limestones, which are covered with a black, porous loam. This, with a precipitation of 35 and 40 inches, gives large quantities of underground water at a medium depth. There are large belts of timber along this river and all its tributaries, increasing in size to the south, where the forest covers all the bottom lands and a large part of the upland. The cultivated area in Kansas is about 59 per cent of the drainage area; in Indian Territory it is

much less. The general slope of the basin is small and the streams are very crooked, with much débris in the channels, causing a very low velocity. Any heavy rainfall of long duration gives a flood which covers all the low bottom lands. The bottom lands in Kansas are generally cultivated and suffer damage, but those in Indian Territory are not generally under cultivation, and the damage is not great. The extreme flood height at the gaging station at Catoosa, Ind. T., was 48.8 feet and at Independence, Kans., 36 feet. These floods are liable to occur at any time during spring, summer, or fall. A few small lakes or ponds lie along the lower course of Verdigris River, but they are not of great extent. There are no irrigation works, and only a few water-power sites for mills, and most of these are abandoned. Along the middle course of the Verdigris are many large gas and oil wells, this portion of the basin being in the gas and oil belt of Kansas.

VERDIGRIS RIVER NEAR INDEPENDENCE, KANS.

This station was established April 20, 1904, by M. C. Hinderlider, for the purpose of making flood observations. It is located at the highway bridge three-fourths of a mile northwest of Independence, Kans.

The channel is straight for one-fourth mile above and below the station. The current is swift. Both banks are high rock cliffs covered with trees. The left bank overflows during floods. The bed of the stream is composed of gravel and bed rock, and is permanent. There is but one channel, divided at higher stages by one stone pier.

Discharge measurements are made from the downstream side of the two-span bridge. The initial point for soundings is the south face of the north abutment.

A standard chain is attached to the upstream guard rail near the south end of the bridge. There were no gage heights during 1905. Bench marks were established as follows: (1) The top of the capstone on the upstream side of the main pier in the stream, marked "+U. S. B. M. No. 1;" elevation, 44.11 feet. (2) The top stone of the north abutment at the end of the bridge on the upstream side, marked "U. S. B. M. No. 2;" elevation, 42.69 feet. (3) The top of the stone step in the upstream wing of the north abutment, marked "U.S.B. M.No.3;" elevation,38.00 feet. (4)The topof the stone in the upstream wing wall of the south abutment, marked "+U. S. B. M. No. 4;" elevation, 45.17 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pages 151–152.

Discharge measurements of Verdigris River near Independence, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 16	W. G. Russell	134	689	3.71	7.35	2,555
June 16	do	137	765	3.67	7.80	2,809
July 26	do	45	84	1.56	2.40	131
August 22	do	97	276	3.16	4.20	872
September 28	do	98	263	3.36	3.90	884

VERDIGRIS RIVER NEAR CATOOSA, IND. T.

This station was established September 25, 1903, by W. G. Russell. It is located at the Frisco Railway bridge, 2 miles northeast of Catoosa, Ind. T.

The channel is straight for 200 feet above and below the bridge. The current is sluggish. Both banks are low, wooded, and subject to overflow, but all water passes beneath the bridge and its approaches. At low water there is one channel, and at high water the channel is broken by the stone piers in the pile supports of the bridge, making five channels. The gaging section is obstructed by broken piles, on which drift collects. During high water it is

impossible to get any but surface velocities, and much of the current out of the main channel has a very low velocity.

Discharge measurements are made from the single-span steel railway bridge and its approaches. The initial point for soundings is at the west end of the bridge, 338 feet from the zero of the gage scale.

A standard chain gage is attached to the guard rail of the railway bridge. During 1905 the gage was read by John L. Calloway. The bench mark is the top of the second stone pier from the west and upstream side of the bridge; elevation, 50.21 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 260; 131, p 153.
Discharge: 131, p 153.
Gage heights: 99, p 261; 131, p 154.

Discharge measurements of Verdigris River near Catoosa, Ind. T., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 9	W. G. Russell	192	1,213	3.20	8.90	3,881
May 10	do	182	871	3.06	7.05	2,670
October 12	do	143	290	1.12	3.90	326

Daily gage height, in feet, of Verdigris River near Catoosa, Ind. T., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	4.4	12.0	7.7	7.4	37.65	10.2	9.25	9.8	10.6	21.4	6.9
2	3.7	4.4	10.1	7.0	7.4	27.4	11.0	9.1	9.3	10.05	16.9	6.5
3	3.6	4.4	9.8	6.9	7.3	24.4	18.7	9.1	9.15	10.0	11.7	6.2
4	3.5	4.4	8.0	6.8	7.1	25.6	8.75	9.1	8.2	9.2	7.5	6.0
5	3.5	4.4	7.9	6.7	7.0	25.4	6.05	8.4	8.7	9.1	5.4	5.1
6	3.5	4.4	7.9	6.6	11.8	25.2	11.25	8.4	9.15	9.0	18.9	5.8
7	3.5	4.3	9.8	6.6	12.1	25.8	26.25	8.2	8.1	8.2	21.8	5.5
8	3.5	4.2	31.2	6.6	8.1	16.3	29.1	8.2	9.7	7.4	25.0	5.3
9	3.5	4.0	28.05	6.6	9.0	12.0	27.2	7.3	10.7	6.6	20.4	5.1
10	3.6	4.0	24.0	6.9	8.7	9.4	19.2	7.3	11.15	5.7	15.2	5.1
11	3.6	4.0	22.1	6.9	8.9	9.5	16.7	7.2	10.6	4.8	9.3	5.0
12	3.7	4.0	18.2	6.5	8.9	8.1	11.25	7.2	10.1	3.9	6.8	5.0
13	3.7	4.0	14.3	6.5	10.7	7.2	8.2	8.7	10.6	3.8	6.4	5.0
14	3.8	4.0	12.1	8.2	12.4	6.9	8.1	12.1	10.3	3.4	6.5	5.0
15	3.8	4.0	9.1	7.0	10.4	7.2	8.25	12.4	10.2	3.0	6.8	4.1
16	3.8	4.0	8.0	7.0	9.0	7.9	.....	9.75	10.7	2.8	6.5	4.1
17	3.8	4.0	8.9	7.0	8.5	9.3	13.7	7.15	10.1	2.4	5.2	4.9
18	3.8	3.9	9.4	7.4	8.7	9.8	19.45	7.0	10.65	18.8	4.1	4.8
19	3.9	3.9	32.15	7.8	8.7	10.1	20.85	6.3	10.3	15.5	4.8	4.6
20	3.9	4.0	36.0	7.9	13.85	12.5	21.5	10.35	11.15	14.8	5.8	4.2
21	3.9	4.4	27.8	7.9	11.9	12.0	20.15	20.75	10.15	7.8	5.8	4.4
22	4.0	4.5	15.1	7.9	11.9	9.0	18.65	26.7	10.1	6.4	5.4	4.4
23	4.1	5.2	10.0	7.8	10.8	8.2	19.2	28.25	10.15	5.5	5.3	4.4
24	4.1	8.3	6.5	7.9	10.7	7.9	17.6	22.35	11.15	4.1	5.2	4.3
25	4.1	18.4	6.4	7.9	10.8	7.5	16.1	18.85	11.1	7.7	5.1	4.8
26	4.1	29.3	6.3	7.9	10.8	7.4	16.0	16.8	10.1	25.5	3.5	4.8
27	4.0	24.0	6.0	8.0	11.4	7.2	15.05	14.2	10.2	18.6	7.9	4.8
28	4.0	14.0	6.3	7.9	20.25	7.0	27.25	14.2	10.1	15.2	8.9	4.8
29	4.0	.....	8.6	7.8	22.9	6.8	10.5	14.2	11.45	10.3	7.6	4.8
30	4.3	.....	9.6	7.6	42.5	6.7	9.4	14.2	10.6	8.1	7.2	4.8
31	4.4	.....	9.7	.....	42.5	.....	9.4	12.2	.....	10.2	.....	5.3

FALL RIVER AT FALL RIVER, KANS.

This station was established as a flood station, April 22, 1904, by M. C. Hinderlider. It is located at the highway bridge one-eighth mile north of Fall River, Kans.

The channel is straight for about 300 feet above and 500 feet below the station, and the current is sluggish at low stages and swift at high stages. The right bank is of loam, sloping gradually out for about 100 feet to sandstone cliffs from 10 to 15 feet high. The left bank slopes at an angle of about 45° to the height of the bridge floor. Both banks are timbered and do not overflow except at extreme stages. The low ground on the left bank extending outward from the northwest end of the bridge is overflowed at very high stages of the river. The bed of the stream is composed of loam and mud and is probably unstable.

Discharge measurements are made from the three-span bridge to which the gage is attached. The initial point for soundings is the surface of the ground at the north side of the right abutment.

A standard chain gage is fastened to the downstream railing near the left end of the bridge. During 1905 the gage was read once daily, and hourly during dangerous rises in the stream, by Jesse McDaniel. Bench marks were established as follows: (1) The top of the south masonry abutment on the downstream side; elevation, 41.768 feet. (2) On the sandstone ledge at the foot of the northeast corner of the south abutment; elevation, 33.777 feet. (3) The top of the first pier from the right bank, downstream side; elevation, 41.03 feet. (4) The top of the second pier from the right bank, downstream side; elevation, 40.08 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water Supply Paper No. 131, United States Geological Survey, pages 154–155.

Discharge measurements of Fall River at Fall River, Kans., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 31	W. G. Russell	95	229	0.71	3.20	164
September 29	do	92	196	.46	2.90	91

Daily gage height, in feet, of Fall River at Fall River, Kans., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.2	2.0	3.2	2.4	2.4	3.4	3.8	3.0	2.0
2	2.1	2.0	3.0	2.4	2.4	3.6	4.0	3.0	2.0
3	2.1	2.0	3.0	2.9	2.4	6.8	17.5	3.0	2.0
4	2.0	2.0	2.8	2.6	2.4	4.0	7.5	2.9	2.0
5	2.0	2.0	2.6	2.6	2.4	3.6	5.75	2.8	2.0
6	2.0	2.0	2.4	2.4	2.4	3.6	5.4	2.7	2.0
7	2.0	2.0	2.4	2.4	2.4	3.6	5.0	2.6	2.0
8	2.0	2.0	2.3	2.4	2.4	3.5	4.7	2.5	2.0
9	2.0	2.0	2.3	2.4	2.4	3.5	5.6	2.5	2.0
10	2.0	2.0	2.3	2.4	2.4	3.2	5.0	2.5	2.0
11	2.0	2.0	2.2	2.4	2.4	3.2	4.6	2.4	2.0
12	2.0	2.0	2.1	2.4	2.4	3.2	4.1	2.4	2.0
13	2.0	2.0	2.1	2.4	2.4	3.2	3.75	2.4	2.0
14	2.0	2.0	2.1	2.4	2.4	3.0	3.6	2.3	2.4
15	2.0	2.0	2.1	2.4	2.4	3.0	3.6	2.3	3.0
16	2.0	2.0	2.1	2.4	2.4	11.3	3.6	2.3	3.0
17	2.0	2.0	2.1	2.4	2.4	8.0	3.55	2.3	28.0
18	2.0	2.0	2.8	2.3	2.4	6.0	3.6	2.3	16.0
19	2.0	2.0	2.6	2.3	2.4	4.0	3.5	2.2	18.25
20	2.0	2.0	2.4	2.3	2.4	3.6	3.5	2.2	7.1
21	2.0	2.8	2.4	2.3	2.4	3.6	3.5	2.2	5.25
22	2.0	3.6	2.8	2.3	2.4	3.6	3.5	2.2	4.25
23	2.0	4.6	2.6	2.8	2.4	3.6	3.4	2.1	3.7
24	2.0	4.0	2.4	2.8	2.4	3.6	3.3	2.1	3.4
25	2.0	3.5	2.4	2.6	2.4	3.6	3.2	2.0	3.8
26	2.0	3.5	2.4	2.4	2.4	3.6	3.2	2.0	3.1
27	2.0	3.2	2.3	2.4	2.6	3.5	3.0	2.0	3.0
28	2.0	3.0	2.2	2.4	2.8	3.5	2.9	2.0	3.0
29	2.0	.....	2.2	2.4	4.0	3.6	2.8	2.0	3.0
30	2.0	.....	2.4	2.4	6.0	3.6	3.0	2.0	3.0
31	2.0	.....	2.4	.....	3.2	.....	3.0	2.0	.....

NEOSHO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Neosho River rises in central Kansas, flows to the east and southeast, draining eastern and southeastern Kansas, and then flows southward into Arkansas River just below Fort Gibson, Ind. T. Its drainage basin lies between those of Kansas and Osage rivers on the north and east, and of Arkansas and Verdigris rivers on the south and west, being entirely within the humid belt and east of the Great Plains. The drainage basin extends east and west from central Kansas to western Missouri, about 200 miles, and north and south into Indian Territory about the same distance, giving an area of 12,660 square miles. The Neosho has many small tributaries, and flows through a rich agricultural country. It has no mountain tributaries, but depends on the precipitation within its basin for its water supply.

The upper course of Neosho River lies in the Permian and upper Coal Measures, which are shales, clays, and broken limestones, the overlying soil being a loose, porous loam. The land is rather rolling and hilly, except along the streams, which have a large percentage of bottom land. The elevation at the headwaters is about 1,230 feet and at Wyandotte about 758 feet. The precipitation within this part of the basin is 30 to 35 inches per annum. The middle course lies in the upper Coal Measures, except for a short distance in the lower part, where it extends into the lower Coal Measures. In this stretch the formation is principally

a broken limestone, overlain by a porous loam. The lower course of the river lies in the lower Coal Measures, most of the rocks being limestones, somewhat broken, with an overlying soil of black porous loam, which permits the water to percolate through into the lower strata. This gives plenty of underground water, and many springs. The Neosho above the mouth of Spring River flows through the large oil and gas belts of Kansas. The precipitation in the middle and lower courses ranges from 35 to more than 40 inches per year. This part of Neosho River is very crooked and has a light slope, and the valley is subject to frequent and destructive floods. In many places dikes have been built to keep out the water, and the railroads have raised their tracks to get above it. There are a few dams on this part of the river for mills and power purposes, but the sites are on the lowlands and give a low fall. There are no power plants on Neosho River below Wyandotte, but one or more are under contemplation. The fall of the Neosho from Wyandotte to Fort Gibson is about 242 feet. In the upper part of this section of the basin the timber is in belts along the streams, while in the lower part it is in large bodies and the sections of prairie land are very scattering. The percentage of cultivated land along Neosho River in Kansas is 60 per cent; along Spring River and the Neosho below Wyandotte it is much less.

Spring River, the main tributary of Neosho River, rises in southwestern Missouri and flows through the lead and zinc regions in a southwest course into Kansas and then southward into Indian Territory. Its entire course is through rolling and broken country, except along the stream bottom. This is a grazing, agricultural, and mining region, the lead and zinc industry along the upper and middle courses of Spring River being very extensive. The soil is rocky, but in places there is considerable porous loam which allows the water to percolate into the lower strata, giving good underground water at a medium depth. The precipitation in the basin of Spring River is at least 40 inches per year; if this falls suddenly and in large quantities the channel of the river is not capable of carrying it off and destructive floods follow. The worst flood for many years occurred in July, 1905. There is a large electric power plant on Spring River at Lowell, Kans., with a fine concrete dam and powerhouse, which furnishes electricity for several cities along this river and in the vicinity. This dam and plant withstood the flood without any material damage.

NEOSHO RIVER AT FORT GIBSON, IND. T.[a]

This station was established September 22, 1903, by W. G. Russell. It is located at the Missouri Pacific Railway bridge, three-fourths of a mile northwest of Fort Gibson, Ind. T.

The channel is straight for about 500 feet above and below the station. The current is sluggish except at high water, when it is swift near the right bank. The right bank is high and wooded, and overflows only at very high stages. The left bank is high, rocky, and clean, and does not overflow. The bed of the stream is a smooth rock from the left bank to the middle; on the right it is sand and changes with every flood. There are four channels at low and five at high water. Drift at very high water makes it impossible to get other than surface velocities. October 11, 1905, the fall of the river from a point above the gaging station to a point about the same distance below, 620 feet distant, was 0.059 foot, which gives a slope of 0.00009516.

Discharge measurements are made from the downstream side of the three-span steel bridge. The bridge has a total length of 625 feet, with a pile approach of 157 feet at the west end. It is slightly oblique to the course of the current. The initial point for soundings is the edge of the abutment on the left bank of the river.

There are two sections of the gage. The first is a vertical staff fastened to the east face of the first stone pier from the left bank. The 9-foot mark is the top of the steel caisson and below this point gage heights are taken by means of a standard chain gage let down from a nail in the guard rail, along which the scale is marked. This gage is used only in very low or very high water and is kept in the pump house when not in use. During 1905 the gage was read once each day by W. L. Blackwell. Bench marks were established as follows:

[a] Formerly known as Grand River.

(1) A cross, marked "B. M," on a hard limestone rock in the face of the wall 4 feet above the upstream side of the bridge on the left bank of the river; elevation, 24.90 feet above the datum of the gage. (2) A United States Geological Survey standard bench mark, marked "516," on the top of the east bridge pier; elevation, 516 feet above sea level and 40.94 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 37, p 268; 99, p 257; 131, pp 158-159.
Discharge: 37, p 268; 131, p 159.
Gage heights: 37, p 268; 99, p 257; 131, p 160.

Discharge measurements of Neosho River at Fort Gibson, Ind. T., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 7	W. G. Russell	495	4,227	2.01	11.40	8,484
May 8	do	499	4,436	2.57	11.90	11,400
June 30	do	493	3,871	1.41	11.00	5,457
October 11	do	468	3,135	.83	9.90	2,588

Daily gage height, in feet, of Neosho River at Fort Gibson, Ind. T., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.0	9.8	15.1	12.5	10.6	20.0	12.0	17.0	11.5	14.2	13.0	11.0
2	9.0	9.8	14.3	12.7	10.6	19.0	13.5	17.5	10.2	14.0	.....	10.8
3	9.0	9.8	13.0	14.0	10.6	17.0	13.5	17.0	10.0	14.0	16.5	10.6
4	9.0	.....	12.0	14.7	10.5	17.0	14.0	15.0	10.0	13.8	15.5	10.5
5	9.0	.....	12.0	14.5	10.5	16.0	14.0	14.5	10.5	13.6	14.0	10.4
6	9.0	.....	12.0	14.0	10.6	15.0	17.0	14.0	.....	13.5	12.5	10.4
7	9.0	.....	12.4	13.5	11.3	14.0	16.5	13.5	10.8	13.4	12.8	10.4
8	9.0	.....	12.8	13.0	11.8	19.0	16.0	13.0	11.0	13.3	13.8	10.4
9	9.1	.....	13.8	12.5	11.9	16.0	15.5	12.8	10.8	13.2	14.8	10.4
10	9.2	.....	17.0	12.0	12.0	14.0	16.0	12.6	10.6	13.2	13.0	10.4
11	9.2	.....	17.5	12.0	11.6	13.8	15.5	12.8	11.6	13.0	12.5	10.3
12	9.2	8.33	15.0	12.0	11.4	13.6	15.0	12.6	11.5	12.5	12.0	10.3
13	9.2	8.33	14.0	12.0	11.4	13.4	14.5	12.0	12.5	12.0	11.6	10.3
14	9.2	8.33	14.0	12.0	13.0	13.6	14.0	11.8	14.5	11.8	11.5	10.3
15	9.2	8.33	13.5	11.7	12.5	13.4	13.5	11.6	12.5	11.6	11.4	10.2
16	9.2	8.33	13.0	11.4	12.3	13.0	13.0	11.4	12.3	11.0	11.3	10.2
17	9.2	8.33	12.9	11.2	13.3	12.9	12.8	12.0	12.2	10.5	11.0	10.2
18	9.4	8.33	13.0	11.0	13.5	12.8	12.6	12.6	14.2	10.4	11.0	10.1
19	9.4	9.0	15.5	11.0	13.7	13.0	12.4	12.8	15.2	13.4	10.9	10.0
20	9.4	9.1	18.0	11.0	12.7	12.8	12.2	18.0	16.4	14.0	10.8	10.0
21	9.5	9.1	18.7	11.0	18.0	12.4	12.0	23.5	16.4	14.0	10.7	9.8
22	9.5	9.2	16.5	11.0	17.0	14.4	14.5	20.0	16.3	13.9	10.7	9.8
23	9.5	9.5	15.0	10.9	17.0	14.4	16.5	18.0	15.8	13.6	10.6	9.8
24	9.5	9.7	13.5	10.9	17.0	13.4	17.5	16.0	15.5	13.3	10.6	9.7
25	9.5	9.8	12.5	10.9	16.5	13.2	15.5	15.0	15.3	13.4	10.5	9.7
26	9.5	9.9	12.0	10,8	16.5	13.2	14.0	14.0	15.1	13.2	10.5	9.6
27	9.5	15.1	12.0	10.8	16.0	13.0	13.8	12.5	15.0	17.2	10.5	10.0
28	9.5	16.1	12.0	10.8	15.5	12.8	12.8	12.0	15.0	17.2	10.5	10.2
29	9.7	.....	12.0	10.8	24.0	11.6	13.5	11.5	14.8	15.0	10.5	10.6
30	9.7	.....	12.1	10.8	20.0	11.0	17.5	11.2	14.6	14.0	11.0	10.6
31	9.8	.....	12.5	.....	19.0	.....	.....	11.0	.....	13.5	.....	10.5

NOTE.—River frozen over February 4-11, inclusive.

CANADIAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Canadian River rises in the mountains of Colfax County, N. Mex., flows southward across Mora and San Miguel counties, then turns to the east and flows across northern Texas, Oklahoma, and Indian Territory, uniting with Arkansas River about 80 miles above Fort Smith, Ark.

The drainage area is wooded in the upper portion and in Indian Territory, but consists of dry plains in Texas and Oklahoma. There are few tributaries, Ute Creek and Mora and Sapello rivers in New Mexico being the principal ones. The run-off is very uncertain, varying from extreme floods to practically nothing in a dry season.

CANADIAN RIVER AT CALVIN, IND. T.

This station was established in 1904 by the United States Weather Bureau. It is located at the railroad bridge about one-fourth mile west of Calvin, Ind. T.

The channel is straight for 2,000 feet above and below the station. The current is swift, and is oblique to the bridge at times. Neither bank will overflow beyond the limits of the bridge and trestle approach. The bed of the stream is composed of clean sand, and is shifting. There is but one channel, divided by the piers of the bridge and somewhat obstructed by old piles and drift caught on them.

Discharge measurements are made from the upstream side of the three-span bridge to which the gage is attached. The bridge has a total length of 835 feet, with a trestle approach of 30 feet at the left bank. The initial point for soundings is the face of the right abutment, upstream side.

A standard chain gage is fastened to the upstream side of the bridge near the middle of the stream; length of the chain, 28.00 feet. During 1905 the gage was read once each day by the United States Weather Bureau observer. Bench marks were established as follows: (1) A United States Geological Survey standard bench-mark post, marked "715," about 100 yards west of the Calvin depot; elevation, 28.72 feet. (2) On the right abutment, upstream side; elevation, 20.42 feet. (3) On the upstream end of the crossbeam, 353 feet from the initial point; elevation, 26.32 feet.

Discharge measurements of Canadian River at Calvin, Ind. T., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
July 28	J. M. Giles	622	1,578	5.38	4.37	8,496
July 28	do	622	1,533	5.81	4.32	8,916
July 29	do	496	1,590	4.44	4.15	7,054
July 29	do	479	1,518	4.26	4.05	6,456
September 24	E. R. Kerby	155	272	1.98	2.40	539
September 27	J. M. Giles	114	168	1.48	2.22	248
September 27	do	114	160	1.46	2.21	233
October 10	E. R. Kerby	60	50	1.82	2.00	91
November 16	do	.....	1,163	3.94	3.70	4,589
November 18	do	.....	869	2.90	3.20	2,520
December 12	do	.....	203	2.39	2.70	485

Daily gage height, in feet, of Canadian River at Calvin, Ind. T., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1	0.4	0.1	2.1	1.5	4.1	6.0	2.4	5.2	2.1	2.1	1.9	4.7
2	.3	.....	1.8	1.7	3.8	4.8	3.1	2.9	2.0	4.4	1.9	3.8
3	.3	.....	1.5	3.2	3.3	4.1	3.1	2.8	2.2	2.9	1.9	3.8
4	.3	.....	1.2	2.7	3.8	3.7	3.2	2.7	2.0	2.7	2.2	3.1
5	.2	.....	1.1	2.3	4.0	3.4	3.1	2.4	2.2	2.3	2.6	3.0
6	.2	.....	1.5	2.0	4.1	3.2	3.1	2.6	2.0	2.2	2.2	2.8
7	.2	.....	2.0	4.0	3.9	3.0	3.0	2.9	1.9	2.1	2.1	2.4
8	.2	.....	1.9	3.8	3.7	2.8	2.8	4.0	2.2	2.0	2.3	2.2
9	.2	.....	2.2	3.4	3.5	2.8	2.7	3.7	2.7	2.0	2.6	2.0
10	.6	.....	1.8	3.0	3.2	3.7	3.6	3.4	4.2	2.0	2.3	2.6
11	.8	.....	1.2	3.0	3.2	3.2	3.2	3.1	4.0	2.0	2.6	2.6
12	1.0	.....	1.7	2.6	3.4	3.8	3.0	3.0	4.7	1.9	2.5	2.6
13	.....	.....	1.6	2.5	4.6	3.4	3.0	2.9	4.6	1.9	2.4	2.8
14	.....	.....	1.7	2.8	4.5	2.9	3.0	3.1	4.3	2.0	2.3	3.0
15	.....	.....	2.1	2.5	3.7	2.4	3.4	3.6	3.7	1.8	4.4	2.5
16	.....	.....	2.0	2.5	3.7	2.7	3.2	4.2	3.6	1.9	3.9	2.5
17	.....	.....	1.8	2.6	3.4	2.3	3.6	5.2	2.9	2.2	3.8	2.6
18	.6	.....	2.4	2.4	3.1	2.6	3.6	4.0	2.8	2.3	3.2	2.7
19	.5	.....	2.2	3.0	3.0	2.5	3.6	3.6	2.8	2.9	3.0	2.6
20	.5	.....	2.5	3.0	7.0	2.8	4.1	3.8	2.5	2.0	3.0	3.8
21	.5	.....	2.8	2.9	6.0	2.9	3.4	3.1	2.5	2.0	2.9	3.6
22	.5	1.1	2.3	2.9	6.5	2.6	3.1	3.0	2.4	2.0	2.8	3.4
23	.3	1.9	2.1	2.8	5.7	2.2	3.2	2.8	2.4	1.9	2.8	3.3
24	.2	2.8	1.9	2.7	4.1	2.6	3.1	2.5	2.4	2.0	3.1	3.2
25	.....	2.2	1.8	2.8	3.8	2.2	3.0	2.4	2.3	2.0	2.5	3.0
26	.....	3.5	1.7	3.5	4.8	2.5	3.4	2.3	2.2	2.0	2.5	3.0
27	.....	2.7	1.7	2.8	14.8	2.2	2.8	2.3	2.2	1.9	2.5	2.9
28	.1	2.5	2.0	6.5	8.4	2.1	2.7	2.2	2.1	1.9	3.9	3.0
29	.2	.....	2.0	5.4	10.0	2.8	4.2	2.2	2.2	1.9	5.4	3.0
30	.1	.....	2.0	5.0	8.0	2.4	3.8	2.2	2.1	1.9	4.9	2.9
31	.1	.....	1.6	.....	7.2	.....	3.7	2.1	.....	1.9	.....	3.0

NOTE.—River frozen January 13-17, 25-27, and February 2-21.

Station rating table for Canadian River at Calvin, Ind. T., from July 1 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	10	2.80	1,310	3.80	4,870	4.80	12,160
1.90	40	2.90	1,570	3.90	5,440	4.90	13,000
2.00	90	3.00	1,840	4.00	6,060	5.00	13,850
2.10	160	3.10	2,120	4.10	6,720	5.10	14,700
2.20	260	3.20	2,420	4.20	7,420	5.20	15,600
2.30	380	3.30	2,740	4.30	8,150	5.30	16,500
2.40	520	3.40	3,080	4.40	8,910	5.40	17,400
2.50	680	3.50	3,460	4.50	9,700		
2.60	860	3.60	3,880	4.60	10,510		
2.70	1,070	3.70	4,350	4.70	11,330		

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 2 feet and 4.5 feet. Owing to the shifting character of the stream the table should not be applied prior to July 1, as there were no measurements before that date. The only measurement in December indicates a decided change in conditions For that reason no estimate is made.

Estimated monthly discharge of Canadian River at Calvin, Ind. T., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July	7,420	520	2,742	168,600
August	15,600	160	3,017	185,500
September	11,330	40	2,087	124,200
October	8,910	10	476	29,270
November	17,400	40	2,500	148,800
The period				656,400

CANADIAN RIVER NEAR LOGAN, N. MEX.

This station was established June 29, 1904, by W. G. Russell. It is located at the bridge of the Chicago, Rock Island and Pacific Railroad, 1 mile west of the depot at Logan, N. Mex. The station was discontinued February 26, 1905, though discharge measurements were made afterward.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pages 160–162.

Discharge measurements of Canadian River near Logan, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Second-feet.*
October 10	Earl Patterson	30	22	0.61	14
November 20	do	43	43	1.70	73

Daily gage height, in feet, of Canadian River near Logan, N. Mex., for 1905.

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1	2.0	2.1	12	2.0	2.0	23	2.0	2.6
2	2.0	2.1	13	2.0	2.0	24	2.0	2.6
3	2.0	2.1	14	2.0	2.0	25	2.0	2.55
4	2.0	2.1	15	2.0	2.0	26	2.0	2.4
5	2.0	2.2	16	2.0	2.0	27	2.0	.....
6	2.0	2.2	17	2.9	2.1	28	2.0	.....
7	2.0	2.2	18	2.9	2.1	29	2.2	.....
8	2.1	2.1	19	2.9	2.2	30	2.2	.....
9	2.1	2.1	20	2.9	2.85	31	2.2	.....
10	2.1	2.1	21	2.9	3.25			
11	2.1	2.0	22	2.9	2.65			

MORA RIVER AT LA CUEVA, N. MEX.

This station was established August 25, 1903, by M. C. Hinderlider. It is located at the wagon bridge at the village of La Cueva, N. Mex. La Cueva is situated in the Mora land grant, 26 miles directly north of Las Vegas. During the flood of September 29, 1904, the bridge to which the gage was attached was carried away and as a result records were discontinued for the remainder of the year. The station was reestablished April 29, 1905, at the old section, the bridge having been replaced.

This station is one-fourth mile below the dam site of the La Cueva reservoir, and was established to determine the amount of water available for storage in the reservoir for use on valley lands below. The Mora canal diverts water from Mora River a short distance above this gaging station. At low water practically the entire flow of the river is diverted by this canal, part of it being at times used for power for a gristmill and returned to the river above the station. At other times the entire volume in the canal is carried through to a system of storage reservoirs, below which the water is used for irrigation. No data of value concerning the canal have been secured during 1905.

The channel is straight for 50 feet above and 120 feet below the station. The bed of the stream is composed of solid rock which is partly covered with a loose deposit of shifting sand and gravel. The left bank consists of sand and gravel, is low, and overflows at high water. The right bank is a series of sandstone ledges. There is but one channel at all stages.

The bridge from which discharge measurements are made is not quite at a right angle to the stream flow.

The original gage was a vertical rod fastened to the west end of the north abutment of the bridge. April 29, 1905, a staff gage was fastened vertically to the west side of the south abutment of the bridge, the datum being 1.32 feet above that of the original gage. During 1905 the gage was read twice each day by Hugh Loudon, secretary of the La Cueva Land and Cattle Company. The bench mark is a cross cut in the vertical face of the limestone ledge just above the south end of the bridge, marked "U. S. G. S., B. M.;" elevation, 4.51 feet above the datum of the new gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 99, p 249; 131, pp 162-163.
Gage heights: 99, p 249; 131, p 163.

Discharge measurements of Mora River at La Cueva, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 29	R. I. Meeker	24	69	4.50	3.40	310
July 2	do	18	15	1.60	.85	24
August 1	do	22	20	1.70	1.10	34

Daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.55	1.0	3.2	2.2	0.85	1.1	[a]0.8	0.8	0.9	0.9
2	.....	[a].7	.75	3.4	2.2	.8	1.55	.85	.9	.9	.9
3	.....	.85	.75	3.4	2.2	.8	1.4	.85	.9	.9	.9
4	.....	.85	.7	3.0	2.7	.8	1.5	.9	.9	.9	.9
5	.....	.85	.7	2.8	.....	.8	1.4	1.0	.9	.9	.9
6	.....	1.5	.85	2.5	.....	.8	1.7	.9	.9	.9	.9
7	.....	1.3	1.15	2.5	.....	.75	1.4	.85	.8	.9	.85
8	.....	1.1	1.4	2.55	.....	.75	1.4	.9	.8	.9	1.0
9	.....	1.1	1.6	2.9	.....	.8	1.3	.95	.8	.95	.9
10	.....	1.1	1.7	2.6	2.1	.75	1.2	.95	.8	.9	.95
11	.....	1.05	1.7	2.4	2.0	.75	1.2	.9	.7	.9	.85
12	.....	[a]1.05	1.55	2.4	2.0	.75	1.1	.9	.8	.9	.9
13	.....	1.05	1.5	2.4	1.9	.7	1.1	.85	.8	.9	.9
14	.....	1.05	1.45	2.3	1.8	.7	1.1	.85	.8	.9	.9
15	.....	1.05	1.4	2.2	1.7	.7	1.0	.8	.8	.9	.9
16	.....	[a]1.0	1.45	2.4	1.65	.7	1.0	.75	.6	.9	.9
17	.....	1.0	1.4	2.5	1.6	.7	.95	.8	.8	.9	.9
18	.....	.8	1.45	2.5	[a]1.5	.7	.9	.8	.8	.9	.9
19	.....	.85	1.5	2.6	1.4	.7	.85	.8	.8	.9	1.0
20	.....	.9	[a]1.5	2.7	1.4	.7	.85	.6	.75	.9	1.05
21	.....	.85	1.5	2.5	1.3	.7	.75	.55	.95	.9	.9
22	0.4	.8	1.55	2.4	1.3	.9	.7	.55	.9	1.05	.9
23	.45	.8	2.1	2.5	1.2	.9	.8	.6	.9	1.0	.....
24	.45	.75	2.0	2.5	1.2	.8	.8	.6	1.0	.9	.....
25	.45	.8	2.1	2.3	1.2	.75	.8	.6	.95	.9	.....
26	.5	.85	2.3	2.5	1.1	.7	.8	.65	.95	.9	.....
27	.6	[a].8	2.9	2.3	1.05	[a].7	.8	.7	.9	1.1	.....
28	.55	.75	3.0	2.4	1.0	.75	.8	.6	.95	1.0	.....
29	.....	.65	3.3	2.2	.9	.75	.7	.7	.9	1.0	.....
30	.....	.75	3.3	2.1	.9	.8	.7	.6	.9	1.0	.....
31	.....	.7	.....	2.2	.....	.9	[a].75	.....	.9	.....	.....

[a] Interpolated.

NOTE.—River frozen December 23-31.

Station rating table for Mora River at La Cueva, N. Mex., from February 22 to December 22, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	12	1.10	34	2.00	105	2.90	224
0.30	13	1.20	39	2.10	115	3.00	240
0.40	14	1.30	45	2.20	126	3.10	257
0.50	16	1.40	52	2.30	138	3.20	274
0.60	18	1.50	60	2.40	151	3.30	292
0.70	21	1.60	68	2.50	164	3.40	310
0.80	24	1.70	77	2.60	178		
0.90	27	1.80	86	2.70	193		
1.00	30	1.90	95	2.80	208		

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905. On account of the small number of measurements, it should be considered as only approximate.

Estimated monthly discharge of Mora River at La Cueva, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
February 22-28	18	14	15.7	218
March	60	17	28.2	1,734
April	292	21	87.1	5,183
May	310	115	175.	10,760
June (25 days)	193	27	72.6	3,600
July	27	21	22.8	1,402
August	77	21	35.0	2,152
September	30	17	23.2	1,380
October	30	18	25.4	1,562
November	34	27	27.8	1,654
December 1-22	32	26	27.5	1,200
The period				30,840

SAPELLO RIVER AT LOS ALAMOS, N. MEX.

This station was established August 22, 1903, by M. C. Hinderlider. It is located at a ford crossing Sapello River at a point about one-fourth mile due north from Los Alamos, N. Mex. Los Alamos is about 13 miles north of Las Vegas. The establishment of this station was for the purpose of determining the available amount of water for prospective diversion into the San Guijuela reservoir for the Las Vegas project. This basin lies about 6 miles northwest of Las Vegas.

The channel at the cable is about 125 feet wide and is straight above and below for 200 feet each way. The bed is composed of bowlders, cobblestones, sand, and gravel. The banks are of alluvial material, which erodes easily, and are about 10 feet high. There is but one channel at all stages. Gage heights range from 0 to 5 feet. The current is strong at all stages.

Discharge measurements were originally made by wading. In March, 1904, a cable, car, and tagged wire were installed for use during high water.

The original gage was an inclined staff 500 feet below the cable. September 29, 1904, the gage was destroyed by a disastrous flood which swept down this valley. Records were discontinued until April, 1905, when a standard chain gage was installed near the cable, about 400 feet above the location of the original gage. This gage is fastened to a cantilever arm on the right bank. The length of the chain is 15.44 feet. During 1905 the gage was read by W. N. Frank, jr. The bench mark is a nail driven into the post supporting the cable at the right bank; elevation, 11.50 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 249-250; 131, pp 166-167.
Discharge: 99, p 250; 131, p 167.
Gage heights: 99, p 250; 131, p 168.

Discharge measurements of Sapello River at Los Alamos, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 3	R. I. Meeker	12	13	2.23	0.90	29
April 28	do	73	91	5.25	2.60	478
July 1	do	12	7.5	1.68	.40	13
August 2	do	12	11	1.73	.65	19

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Sapello River at Los Alamos, N. Mex., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.5	1.5	2.25	1.4	0.4	0.7	0.1	0.1	0.1	0.8
2	.....	2.0	1.6	2.55	1.4	.4	.7	.15	.1	.1	.8
3	0.9	1.75	1.55	2.45	1.4	.3	.65	.4	.1	.1	.8
4	.9	1.7	1.65	2.0	1.35	.3	.65	.4	.1	.15	.6
5	.95	1.7	1.85	2.0	1.2	.25	1.15	.3	.1	.1	.6
6	1.0	2.75	1.9	1.85	1.15	.2	.8	.1	.1	.1	.6
7	.95	2.15	1.95	1.85	1.1	.0	.7	.15	.1	.1	.6
8	.9	1.75	1.85	1.85	1.45	.0	.7	.35	.1	.15	.5
9	1.7	1.65	1.85	1.9	1.35	.0	.6	.85	.1	.1	.5
10	1.05	1.6	1.85	1.75	1.25	.0	.5	.1	.1	.1	.5
11	.95	1.55	1.8	1.75	1.25	.0	1.3	.1	.1	.1	.5
12	.95	1.5	1.8	1.7	1.2	.0	1.2	.1	.1	.1	.5
13	.95	1.5	1.75	1.7	1.2	.0	.6	.2	.1	.1	.5
14	.95	1.4	1.6	1.65	.95	.1	.5	.1	.1	.1	.5
15	1.15	1.4	1.6	1.6	.9	.1	.45	.1	.1	.1	.5
16	1.25	1.4	1.6	1.55	.9	.1	.35	.1	.1	.1	.5
17	1.25	1.3	1.55	1.6	.75	.1	.35	.1	.1	.1	.5
18	1.15	1.25	1.55	1.7	.7	.15	.3	.1	.1	.1	.5
19	1.15	1.15	1.55	1.8	.65	.1	.2	.1	.1	.1	.5
20	1.1	1.15	1.5	1.8	.6	.1	.25	.2	.1	.1	.5
21	1.35	1.15	1.5	1.85	.5	.1	.2	.1	.1	.1	.5
22	1.25	1.2	1.6	1.75	.65	.1	.2	.1	.1	.9	.5
23	1.35	1.25	2.45	1.75	.45	.35	.2	.1	.1	.6	.5
24	1.35	1.25	3.45	1.7	.55	.45	.2	.1	.1	.6	.5
25	1.35	1.25	3.8	1.6	.55	.4	.2	.1	.1	.6	.5
26	1.4	1.25	3.35	1.6	.55	.25	.2	.15	.1	.6	.5
27	1.4	1.25	3.05	1.55	.45	.15	.1	.2	.1	1.9	.5
28	1.5	1.25	2.5	1.5	.35	.1	.15	.2	.1	.9	.5
29	.....	1.15	2.45	1.45	.35	.15	.15	.2	.1	.9	.5
30	.....	1.15	2.4	1.45	.4	.2	.2	.1	.1	.9	.5
31	.....	1.25	.....	1.4	.....	1.35	.15	.....	.1	.....	.5

UTE CREEK NEAR LOGAN, N. MEX.

This station was established August 12, 1904, by W. G. Russell. It is located about 7 miles northwest of Logan, N. Mex., and about 4 miles above the mouth of Ute Creek, near the old Martinez house.

The channel is straight for about 300 feet above the station. The current is sluggish at low and swift at high stages. The right bank is low, clean, and subject to overflow. The left bank is high, rocky, and wooded, and does not overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at all stages.

Discharge measurements are made at low water by wading near the gage. Discharges for high stages must be computed from the slope and cross section. The initial point for soundings is at the gage on the left bank of the stream.

The original gage was washed out May 23, 1905. A new gage was established at the same datum June 30, 1905, the record being kept in the meantime by measuring down from a bench mark. The new gage is an inclined staff fastened to the rock on the left bank of the creek, about 100 feet above the site of the old gage. During 1905 the gage was read once each day by Manuel Martinez. Bench marks were established as follows: (1) A cross painted on the top of a rock on the left bank 200 feet below the gage; elevation, 5.51 feet. (2) The head of a bolt set in a rock 14 feet west of the gage; elevation, 3.46 feet. (3) A cross cut in a sandstone ledge directly over the gage; elevation, 11.89 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 170–171.

Discharge measurements of Ute Creek near Logan, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 3	J. M. Giles	6	4.3	0.90	0.50	3.9
June 6	Earl Patterson	36	13.1	1.35	.80	17.7
June 30	do	10	1.71	.73	.65	1.3
July 1	do	68	58	3.31	1.50	194
July 1	do	68	46	3.13	1.30	145
July 1	do	70	67	3.98	1.60	266
July 1	do	70	74	4.22	1.70	311
July 2	do	54	32	2.50	1.15	80
July 2	do	84	25	2.42	1.05	60
August 20	do	7	2	.63	.75	1.4
October 10	do	1	.13	.14	.70	.02
November 20	do	.....	4.9	1.04	.90	5.1
December 15	do	44	17	1.13	1.10	19

Daily gage height, in feet, of Ute Creek near Logan, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.3	0.3	0.8	0.6	0.8	1.2	1.8	4.9	0.8	0.8	.....	1.2
2	.3	.3	.8	3.8	.6	.9	1.1	4.8	.8	.8	.....	1.1
3	.2	.3	.8	2.9	.5	.6	1.1	4.5	.8	.8	.....	1.1
4	.2	.3	.8	2.2	.4	.6	.9	2.9	.8	.8	.....	1.0
5	.2	.3	.6	1.8	.3	.6	.8	1.1	2.5	.7	.....	.9
6	.2	.3	.8	1.6	.3	.8	.7	1.3	1.9	.7	.....	.9
7	.2	.3	.8	1.4	.3	.8	.6	1.9	2.9	.....	.....	.8
8	.2	.3	.6	1.2	.3	.8	.6	3.3	2.4	.....	1.2	.7
9	.2	.3	.6	1.1	.3	.8	.6	2.5	1.5	.....	2.1	.6
10	.2	.3	.6	.9	.3	.9	.6	1.9	1.8	.....	1.9	.6
11	.3	.3	.4	.9	.3	.9	.5	1.4	1.8	.....	1.5	.6
12	.3	.3	.9	.9	.2	.8	.5	1.0	1.6	.....	1.8	.6
13	.4	.3	.9	.9	.2	.6	.5	1.0	1.1	.....	1.8	1.4
14	.4	.3	.9	.8	.2	.5	.4	.9	.9	.....	1.9	1.2
15	.4	.4	.9	.8	.2	.3	.4	1.1	.8	.....	1.9	1.2
16	.4	.4	.8	.4	.2	.2	.4	.9	1.3	.....	1.6	1.2
17	.4	.4	.8	.4	.2	.2	.4	.8	1.1	.....	1.1	1.2
18	.4	.3	.8	.4	.2	.2	.4	.6	1.1	.....	.9	1.2
19	.5	.3	.4	.4	.2	.2	.4	.6	.9	.....	.9	1.2
20	.5	.8	.4	.3	1.6	.2	.4	.6	.7	.....	.9	1.2
21	.5	1.1	.5	.4	.9	.4	.9	.5	.7	.....	.9	1.2
22	.5	.9	.5	.4	.8	.3	1.5	.5	.7	.....	1.0	1.1
23	.5	.9	.6	3.5	8.8	.2	1.1	.5	.7	.....	2.8	1.0
24	.5	1.6	.6	3.8	5.3	.2	.9	.5	.7	.....	1.6	1.0
25	.5	1.4	.6	3.3	3.9	.2	.9	.5	.7	.....	1.3	1.0
26	.4	1.1	.6	2.5	8.8	.2	.8	.5	.9	.....	1.3	1.0
27	.4	.9	.5	2.1	3.9	.2	.8	.5	.9	.....	1.3	1.0
28	.4	.9	.4	1.5	2.2	.2	.6	.8	.8	.....	1.3	1.0
29	.4	.....	.3	1.0	1.9	.5	.5	.9	.8	.....	1.3	.9
30	.3	.....	.3	.9	1.7	1.8	5.2	.9	.8	.....	1.2	.9
31	.3	.....	.3	.....	1.5	.....	5.1	.8	.....	.....	.....	.9

NOTE.—Creek dry October 7 to November 7, inclusive.

BEAVER CREEK AT BEAVER, OKLA.

This station was established March 29, 1904, by W. G. Russell, and was discontinued December 31, 1905. It is located just below the ford about one-fourth mile north of Beaver, Okla.

The channel is straight for about 300 feet above and below the station and about 95 feet wide at ordinary stages. During the flood of July, 1904, the river was 2,547 feet wide along the highway and across the ford, and the stream bed was eroded. The current is sluggish at low water, but has a good current at high stages. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at all stages.

Discharge measurements are made at low water by wading. It is not possible to make high-water measurements in this vicinity, and the discharge during floods must be computed from the slope and cross section. The initial point for soundings is at the gage.

The original gage was destroyed July 9, 1904. A new inclined gage at the same datum was fastened to posts driven into the bank of the river. June 18, 1905, a similar gage was erected 440 feet downstream and was set to give the same reading at gage height 0.80 foot, the datum being 0.44 foot lower than that of the upper gage. By reading both gages at flood stage the surface slope may be obtained. During 1905 the gage was read once each day by Logan Rock. The bench mark is the top of a pine stake about 0.5 foot above the surface of the ground, 15 feet south of the gage; elevation, 5.00 feet above gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 171-172.

Discharge measurements of Beaver Creek at Beaver, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 17	J. M. Giles	36	38	1.11	0.87	42
June 18	do	48	32	1.26	.82	40
June 19	do	48	26	1.24	.79	33
August 25	do	40	32	1.33	.95	42
November 23	E. Patterson		56	1.42	1.15	79
November 23	do		61	1.55	1.20	95
(a)	J. M. Giles		200	1.94	2.00	388
(a)	do		345	2.45	3.00	845
(a)	do		525	2.84	4.00	1,491

(a) Computed from slope measurements, using Kutter's formula.

Daily gage height, in feet, of Beaver Creek at Beaver, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.2	1.3	1.05	1.6	1.8	0.7	0.4	0.45	0.3	0.8	1.25
2	1.05	1.25	1.25	1.25	1.5	1.8	.65	.45	.45	.3	.8	1.25
3	.9	1.25	1.25	1.2	1.4	1.7	.65	.35	.5	.25	.8	1.2
4	.9	1.3	1.2	1.5	1.3	1.7	.6	.3	.4	.6	.8	1.15
5	.9	1.3	1.15	1.4	1.2	1.65	.6	1.1	.45	.6	1.2	1.15
6	.85	1.3	1.1	1.3	1.2	1.4	.65	.9	.9	.55	1.1	1.15
7	.85	1.35	1.05	1.2	1.1	1.2	.7	.85	1.0	.45	1.0	1.1
8	.85	1.35	1.05	1.2	1.1	1.15	.75	.75	1.05	.55	1.0	1.1
9	.8	1.45	1.0	1.15	1.2	1.1	.65	.75	1.1	.55	1.2	1.1
10	.8	1.45	1.05	1.15	1.3	1.1	.65	.6	1.2	.45	1.15	1.0
11	.8	1.45	1.05	1.15	1.1	1.4	.65	.5	1.2	.55	1.1	.9
12	.85	1.5	1.05	1.1	1.05	1.4	.6	.5	1.25	.6	1.1	.9
13	.9	1.5	1.05	1.1	1.05	1.3	.55	.8	1.3	.6	1.1	.9
14	.9	1.5	1.05	1.05	1.0	1.2	.5	.75	1.4	.65	1.05	.95
15	.9	1.5	1.05	1.2	1.0	1.1	.5	.75	1.3	.65	1.05	.95
16	.9	1.6	1.0	1.1	1.0	.8	.75	.6	1.25	.65	1.05	.95
17	.9	1.4	1.0	1.05	.95	.9	.4	.5	1.1	.7	1.05	1.0
18	.9	1.4	1.05	1.05	.95	.85	.4	1.2	1.0	.7	1.0	1.0
19	.9	1.4	1.05	1.1	1.0	.85	.35	1.0	.9	.7	1.0	1.0
20	1.1	1.35	1.05	1.1	1.0	.8	.45	.5	.8	.75	.95	1.05
21	1.1	1.35	1.05	1.0	1.05	.8	.4	.5	.75	.75	.9	1.05
22	1.5	1.35	1.05	1.0	1.1	.8	.4	.45	.6	.8	.9	1.1
23	1.5	1.3	1.0	1.05	1.1	1.15	.35	1.05	.55	.8	1.5	1.1
24	1.4	1.2	.95	2.0	1.8	1.0	.85	1.0	.5	.8	1.5	1.1
25	1.2	1.15	.9	2.1	1.6	1.0	.75	1.0	.45	.85	1.4	1.15
26	1.3	1.15	.9	2.0	3.0	.85	1.6	.85	.45	.85	1.35	1.2
27	1.25	1.15	.85	3.0	2.6	.85	.85	.8	.4	.85	1.35	1.25
28	1.25	1.15	.85	2.7	2.7	.8	.85	.75	.35	.8	1.35	1.3
29	1.2	.....	.8	2.1	3.1	.75	.8	.7	.3	.8	1.3	1.4
30	1.25	.....	.8	1.7	2.6	.7	.75	.7	.3	.8	1.3	1.4
31	1.2	.....	.85	.....	2.5	.....	.4	.6	.....	.85	.....	1.45

NORTH FORK OF CANADIAN RIVER NEAR WOODWARD, OKLA.

This station was established September 13, 1903, by W. G. Russell. It is located 7 miles east of Woodward, at the railroad bridge.

The channel is straight for 200 feet above and below the station. The right bank is high and not liable to overflow. The left bank is low and liable to overflow under the bridge; there are scattering trees along the bank. The bed of the stream is sandy and shifting. There is but one channel, broken by two piers at low water and five piers at high water.

Discharge measurements are made from the six-span railroad bridge, which has a total length between abutments of 360 feet. The initial point for soundings is at the west end of the bridge.

The original gage is painted on the west face of the second pier from the west end of the bridge. A standard chain gage is fastened to the downstream guard rail of the bridge; length of chain, 18.44 feet. During 1905 the gage was read by Adolph Mueller. The bench mark is the bottom of the coping stone of the pier at the top of the gage; elevation, 7.00 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 245; 131, pp 172-173.
Discharge: 131, p 173.
Gage heights: 99, p 246; 131, p 173.

Discharge measurements of North Fork of Canadian River near Woodward, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 30	W. W. Schlecht	54	104	1.54	2.50	161
April 2	do	172	148	1.21	2.65	179
April 6	do	204	224	1.34	2.96	310
April 15	do	185	130	1.46	2.76	191
May 2	W. G. Russell	169	488	1.77	3.40	865
May 3	do	157	351	2.16	3.20	759
June 8	J. M. Giles	106	123	1.57	2.65	193
June 8	do	142	173	1.18	2.65	205
June 19	Earl Patterson	66	63	1.79	2.40	113
June 22	do	162	196	1.76	2.90	346
July 21	do	81	48	1.46	2.30	71
August 17	do	.....	282	1.77	3.50	500
August 29	do	32	27	1.45	2.10	40
September 19	do	40	37	1.40	2.30	52
October 20	J. M. Giles	28	10	.90	1.85	9
October 28	Earl Patterson	35	25	1.26	2.20	31
November 27	do	.....	178	1.28	2.90	230
December 17	do	161	101	1.31	2.80	133

Daily gage height, in feet, of North Fork of Canadian River near Woodward, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.8	2.9	2.6	3.5	3.9	2.0	2.6	1.9	1.8	2.3	2.8
2	2.5	2.8	2.8	2.6	3.4	3.8	2.2	2.6	1.8	1.8	2.3	2.7
3	2.5	2.8	2.8	2.6	3.2	3.6	2.0	2.5	1.8	1.8	2.3	2.7
4	2.5	2.8	2.7	2.8	3.0	2.9	1.8	2.3	1.8	1.7	2.4	2.6
5	2.5	2.8	2.9	2.9	3.0	2.9	1.8	2.2	1.8	1.7	2.5	2.6
6	2.5	2.8	3.3	2.9	3.0	2.9	1.8	2.2	2.0	1.7	2.5	2.6
7	2.4	2.8	2.9	3.0	3.0	2.8	1.9	2.1	1.9	1.6	2.5	2.7
8	2.4	2.8	2.9	3.0	3.0	2.7	1.9	2.1	2.1	1.6	2.4	2.7
9	2.4	2.8	2.9	2.9	2.9	2.6	2.1	2.0	2.5	1.5	2.5	2.7
10	2.4	2.8	2.9	2.8	2.9	2.6	2.2	1.9	2.4	1.5	2.5	2.7
11	2.4	2.8	2.9	2.8	2.9	2.5	2.1	1.9	2.5	1.5	2.5	2.7
12	2.4	2.8	2.9	2.8	2.8	2.5	2.1	1.9	2.5	1.5	2.6	2.7
13	2.4	2.8	2.8	2.8	2.8	2.5	2.1	3.3	2.4	1.5	2.6	2.7
14	2.4	2.8	2.8	2.8	2.7	2.4	2.1	3.1	2.4	1.5	2.6	2.7
15	2.4	2.8	2.8	2.8	2.6	2.4	2.0	3.0	2.3	1.5	2.6	2.7
16	2.4	2.8	2.8	2.8	2.6	2.4	1.9	3.0	2.2	1.5	2.6	2.7
17	2.4	2.9	2.8	2.8	2.5	2.4	1.9	3.0	2.2	1.5	2.6	2.7
18	2.4	2.9	2.9	2.8	2.5	2.4	1.9	3.6	2.2	1.6	2.6	2.7
19	2.7	2.9	2.9	2.8	2.5	2.4	1.9	3.0	2.1	1.7	2.6	2.7
20	2.7	2.9	3.0	2.7	2.5	2.4	1.8	2.8	2.1	1.8	2.5	2.7
21	2.7	3.1	2.9	2.7	2.6	2.4	1.8	2.8	2.1	1.8	2.5	2.7
22	2.7	3.1	2.8	2.6	2.8	3.4	1.9	2.6	2.1	1.9	2.6	2.7
23	2.8	3.1	2.8	2.6	3.8	2.9	1.8	2.5	2.1	1.9	2.8	2.7
24	2.9	3.0	2.8	2.8	3.6	2.8	2.8	2.3	2.1	1.9	2.8	2.7
25	2.9	2.9	2.8	4.0	3.2	2.8	2.8	2.2	2.0	2.1	4.0	2.6
26	2.9	2.9	2.8	3.8	3.1	2.6	2.6	2.2	1.9	2.1	2.9	2.6
27	2.9	2.9	2.7	3.6	3.1	2.4	2.3	2.2	1.9	2.1	2.9	2.6
28	2.9	2.9	2.6	3.6	3.1	2.0	2.3	2.2	1.9	2.1	2.9	2.7
29	2.8	.....	2.6	3.5	3.9	2.0	2.3	2.2	1.8	2.2	2.9	2.6
30	2.8	.....	2.6	4.5	3.5	2.0	2.9	2.0	1.8	2.2	2.8	2.5
31	2.8	.....	2.5	.....	3.1	.....	2.7	1.9	.....	2.3	.....	2.5

NORTH FORK OF CANADIAN RIVER NEAR ELRENO, OKLA.

This station was established October 27, 1902, by W. G. Russell, and is located at the highway bridge 2 miles north of Elreno, Okla.

The channel both above and below the station is straight for about 200 feet and has a width of 130 feet at ordinary stage. The right bank is high and the left bank is low. Both banks are liable to overflow. The bed of the stream is sandy and somewhat shifting.

Discharge measurements are made from the bridge. The initial point for soundings is the end of the bridge on the right bank.

The original gage was of the wire type. It was destroyed July 6, 1903, but was reestablished July 10, 1903. June 5, 1905, a standard chain gage was fastened to the downstream railing of the bridge; length of chain, 17.46 feet. During 1905 the gage was read once each day by Austin Clift. The bench mark is the top of a steel cylinder pier on the north side of the bridge; elevation, 11.30 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 114; 99, p 244; 131, p 174.
Discharge: 84, p 114; 99, p 244; 131, p 174.
Discharge, monthly: 131, p 177.
Gage heights: 84, p 114; 99, p 244; 131, p 175.
Rating table: 131, p 176.

Discharge measurements of North Fork of Canadian River near Elreno, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 10	E. R. Kerby	106	194	2.18	3.80	423
April 24	Murphy and Kerby	105	200	1.97	3.50	395
April 25	J. M. Giles	105	187	1.64	3.55	307
June 5	do	110	325	2.02	5.13	658
June 17	E. R. Kerby	101	134	1.83	3.10	245
July 1	do	100	128	1.59	2.90	204
July 27	J. M. Giles	63	54	1.02	2.25	56
August 23	E. R. Kerby	104	171	1.63	3.30	278
August 23	do	104	171	1.58	3.25	270
September 23	do	47	26	.84	1.80	22
September 26	J. M. Giles	24	17	.71	1.70	12
October 9	E. R. Kerby	22	8	.50	1.50	4
November 15	do		47	1.12	2.20	53
December 11	do		97	1.32	2.70	128

Daily gage height, in feet, of North Fork of Canadian River near Elreno, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	.....	4.0	3.4	5.0	5.3	2.9	2.3	2.1	1.6	1.6	2.8
2	3.0	.....	4.0	4.1	4.9	5.3	3.0	2.3	1.9	1.6	1.6	2.8
3	2.9	.....	3.8	3.4	5.0	4.9	2.9	2.4	1.9	1.6	1.6	2.9
4	2.9	.....	3.6	3.4	5.4	4.4	2.9	2.3	1.8	1.6	1.7	.8
5	2.8	.....	3.6	3.4	4.8	5.1	2.8	2.5	1.8	1.6	1.7	2.8
6	3.0	.....	3.6	3.6	4.7	4.8	2.6	2.7	1.8	1.6	1.8	2.8
7	3.2	.....	3.7	3.5	4.5	4.4	2.6	2.5	1.8	1.5	1.8	2.7
8	2.8	.....	3.7	3.5	4.0	4.2	2.6	2.7	2.0	1.5	1.8	2.8
9	.....	.....	3.9	3.6	4.0	4.0	2.9	2.3	2.2	1.5	2.0	2.8
10	.....	.....	4.2	4.0	3.9	3.7	2.9	2.2	2.4	1.5	2.0	2.8
11	.....	.....	4.1	3.8	3.7	3.7	2.8	2.1	2.2	1.5	2.1	2.7
12	.....	.....	4.0	3.9	3.7	3.5	2.6	2.2	2.2	1.5	2.1	2.7
13	.....	.....	3.9	4.1	3.6	3.4	2.6	2.3	2.0	1.4	2.1	2.7
14	.....	.....	3.9	4.0	3.8	3.3	2.6	2.2	2.0	1.4	2.1	2.8
15	.....	.....	4.0	3.6	3.9	3.2	2.4	2.2	2.0	1.4	2.1	2.8
16	.....	.....	3.9	3.6	3.6	3.1	2.4	2.3	2.2	1.4	2.2	2.7
17	.....	.....	3.8	3.5	3.4	3.1	2.3	3.2	2.2	1.5	2.2	2.8
18	.....	.....	4.1	3.5	3.2	3.0	2.3	3.0	2.2	1.5	2.2	2.7
19	.....	.....	4.1	3.5	3.2	2.9	2.3	3.1	2.0	1.5	2.3	2.8
20	.....	.....	4.1	3.5	3.4	2.0	2.3	3.2	2.0	1.5	2.3	2.8
21	.....	.....	4.2	3.5	3.4	2.0	2.2	3.3	1.9	1.5	2.4	2.8
22	.....	.....	4.5	3.5	3.4	3.3	2.3	3.4	1.8	1.5	2.4	2.8
23	.....	.....	4.1	3.4	3.5	3.1	2.2	3.4	1.8	1.5	2.4	2.8
24	.....	3.9	4.0	3.5	3.3	2.9	2.6	3.0	1.8	1.5	2.5	2.7
25	.....	8.6	3.9	3.5	3.2	2.9	2.5	2.8	1.8	1.5	2.4	2.7
26	.....	4.8	3.7	3.7	3.2	2.9	2.4	2.6	1.7	1.5	2.4	2.7
27	.....	4.0	3.6	3.6	3.3	3.6	2.2	2.5	1.7	1.5	2.7	2.6
28	.....	3.9	3.6	3.7	4.8	3.3	2.3	2.4	1.7	1.5	2.8	2.6
29	.....	.....	3.4	5.3	4.6	3.0	2.4	2.3	1.7	1.5	2.7	2.6
30	.....	.....	3.4	5.2	4.3	3.0	2.5	2.2	1.6	1.6	2.7	2.6
31	.....	.....	3.4	.....	4.2	.....	2.3	2.1	.....	1.6	.....	2.6

Daily discharge, in second-feet, of North Fork of Canadian River near Elreno, Okla., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	515	370	650	710	187	67	43	11	11	164
2	.....	515	535	625	710	210	67	26	11	11	164
3	.....	464	370	650	615	187	82	26	11	11	187
4	.....	415	370	740	490	187	67	20	11	15	164
5	.....	415	370	600	650	164	99	20	11	15	164
6	.....	415	415	575	580	119	141	20	11	20	164
7	.....	440	395	530	490	119	99	20	8	20	141
8	.....	440	395	410	450	119	141	34	8	20	164
9	.....	490	415	410	410	187	67	54	8	34	164
10	.....	560	515	385	340	187	54	82	8	34	164
11	.....	535	464	330	345	164	43	54	8	43	141
12	.....	515	490	330	300	119	54	54	8	43	141
13	.....	490	535	310	280	119	67	34	6	43	141
14	.....	490	515	360	270	119	54	34	6	43	164
15	.....	515	415	390	255	82	54	34	6	43	164
16	.....	490	415	305	240	82	67	54	6	54	141
17	.....	464	395	260	245	67	256	54	8	54	164
18	.....	535	395	220	210	67	210	54	8	54	141
19	.....	535	395	220	187	67	233	34	8	67	164
20	.....	535	395	260	34	67	256	34	8	67	164
21	.....	560	395	260	34	54	279	26	8	82	164
22	.....	630	395	260	279	67	302	20	8	82	164
23	.....	535	370	280	233	54	302	20	8	82	164
24	490	515	395	240	187	119	210	20	8	99	141
25	.....	490	307	215	187	99	164	20	8	82	141
26	720	440	340	215	187	82	119	15	8	82	141
27	515	415	320	240	350	54	99	15	8	141	119
28	490	415	340	590	279	67	82	15	8	164	119
29	.....	370	720	540	210	82	67	15	8	141	119
30	.....	370	700	470	210	99	54	11	11	141	119
31	.....	370	.....	450	.....	67	43	.....	11	.....	119

NOTE.—From March 1 to June 17 the daily discharge was obtained by indirect method. For the remainder of the year a rating table based on measurements subsequent to June 17 was used.

Estimated monthly discharge of North Fork of Canadian River near Elreno, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	630	370	480	29,510
April	720	307	428	25,470
May	740	215	397	24,410
June	710	34	332	19,760
July	210	54	112	6,887
August	302	43	126	7,747
September	82	11	32.1	1,910
October	11	6	8.5	522
November	164	11	59.9	3,564
December	187	119	151	9,285
The period	.....	.....	.....	129,100

RED RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The headwaters of Red River include several forks, all of which have their sources in northern Texas. Red River takes a general easterly direction along the northern boundary of Texas, and then turns toward the southeast and flows through a low, swampy region in Louisiana into the Mississippi not far from the southern boundary of the State of Mississippi.

North Fork and Salt Fork rise in the Panhandle of Texas and flow in a general southeasterly course across the southwest corner of Oklahoma, uniting with Prairie Dog Fork a short distance above Vernon, Tex. Elm Fork, rising in the same locality, joins North Fork 50 or 75 miles above its mouth. The flow is very uncertain, most of the run-off being flood water after heavy rains. The flow ceases entirely in the late summer and fall in ordinary dry years. The drainage area consists of dry, semiarid plains varied by sandhills in some portions. The underlying rocks are sandstone, limestone, and gypsum in the upper portion and granite where the streams pass through the Wichita Mountains.

Washita River rises in northern Texas, crosses southern Oklahoma, and flows into Red River in the southern part of Indian Territory, about 10 miles from Denison, Tex.

Sulphur Fork of Red River has its headwaters in Hunt and Fannin counties, Tex., flows eastward, forming the boundary between Delta, Red River, and Bowie counties on the north, and Hopkins, Franklin, Titus, Morris, and Cass counties on the south, and empties into Red River in Arkansas about 7 miles north of the Louisiana boundary line. The flow of this river is very unreliable, changing with the rainfall. If the summer is at all dry it ceases altogether, but enough water always remains standing in pools to water stock. During or immediately after protracted or unusually heavy rains the river becomes very wide and deep, floods its bottoms, and often occasions considerable loss of stock and damage to planters and the railroads.

Big Cypress Creek has its headwaters in Franklin and Titus counties, Tex., flows in a general easterly direction, and empties into Red River. The flow of the river is unreliable, varying with the rainfall. In the summer it ceases and the river becomes dry except where the water stands in holes. After long or heavy rains the stream is liable to overflow its banks.

RED RIVER AT ARTHUR CITY, TEX.

This station was established January 1, 1905. The United States Weather Bureau had maintained a gaging station at this point since 1891.

The gage is a vertical staff fastened to one of the piers of the bridge. During 1905 the gage was read by Mrs. Mary Tunnell. Bench marks were established as follows: (1) The base of rail on the bridge above the second section of the Weather Bureau gage; elevation, 411.10 feet above mean sea level, and 48.00 feet above the datum of the gage. (2) A rock with a 12-foot square surface, lying in the river about 300 feet southeast of the railway bridge; elevation, 363.40 feet above mean sea level and 0.30 foot above the datum of the gage.

Discharge measurements of Red River at Arthur City, Tex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second*	*Feet*	*Second-feet.*
March 17	H. H. Fox	290	1,995	2.10	7.6	4,200
March 18	do	506	3,830	3.67	11.0	13,080

Daily gage height, in feet, of Red River at Arthur City, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.3	4.5	8.0	9.2	12.4	23.3	9.2	13.7	6.7	6.0	6.7	9.3
2	4.3	4.5	8.0	10.0	10.8	22.0	8.5	13.5	6.7	6.0	6.3	9.9
3	4.2	4.5	8.0	14.5	10.0	21.0	8.0	13.0	6.0	14.5	6.0	9.3
4	4.2	4.5	7.6	14.8	9.5	19.5	10.5	12.5	5.9	12.1	6.0	9.0
5	4.2	4.5	6.3	14.6	9.5	18.0	10.8	9.2	5.7	11.0	5.8	8.8
6	4.2	4.5	6.3	14.4	9.0	17.0	12.0	9.0	5.7	10.2	5.6	8.5
7	4.2	4.5	6.3	14.0	9.0	15.0	12.5	8.8	5.7	9.8	9.5	8.3
8	4.2	4.5	7.5	11.4	9.5	13.2	12.5	8.2	5.5	7.8	7.8	8.3
9	4.2	4.5	8.9	10.4	9.2	12.0	19.5	8.0	5.5	7.1	7.2	7.7
10	4.2	4.5	8.9	9.5	9.0	11.5	17.5	8.0	5.5	6.6	12.9	7.0
11	4.8	4.5	8.9	9.0	9.0	10.4	14.5	7.4	5.6	6.6	12.7	6.8
12	4.8	4.5	9.5	9.0	8.2	10.0	12.0	7.0	6.0	6.2	12.0	6.6
13	4.8	4.5	9.0	8.0	8.2	9.8	11.0	8.0	11.6	6.2	11.4	6.5
14	4.8	4.5	8.0	7.6	14.0	11.0	10.5	8.0	13.3	6.0	10.0	12.2
15	5.3	4.5	9.4	7.6	14.4	10.5	10.5	8.0	11.5	6.0	11.7	17.2
16	5.3	4.5	9.4	8.4	15.6	10.0	10.5	8.0	10.7	6.0	11.7	13.6
17	5.3	4.5	7.6	8.4	15.0	9.6	10.2	9.8	10.4	6.0	11.2	12.0
18	5.3	4.5	10.8	8.4	14.0	9.0	10.2	9.8	9.8	6.0	10.0	12.4
19	5.6	4.6	13.0	10.0	12.5	8.8	10.7	9.5	9.5	10.0	8.7	11.4
20	5.9	4.8	14.5	9.6	10.5	9.6	10.7	8.4	8.8	12.2	9.2	9.5
21	5.9	4.8	15.5	9.6	16.0	12.0	11.0	9.0	8.2	8.5	8.0	15.0
22	5.0	6.8	15.0	9.0	19.4	12.5	11.3	8.8	8.0	7.0	7.8	14.0
23	4.5	6.8	11.7	9.3	21.2	12.5	13.2	8.6	7.8	7.0	7.8	13.4
24	4.5	7.6	10.3	9.6	18.4	11.4	14.0	8.2	7.8	6.8	7.4	12.0
25	4.5	9.0	9.6	14.8	21.6	11.4	14.2	8.0	7.6	9.9	9.0	11.6
26	4.5	8.7	9.2	15.8	21.0	11.0	13.7	7.7	7.1	9.2	9.0	11.3
27	4.5	8.4	8.7	15.8	18.0	9.5	13.7	7.6	7.0	8.0	9.0	9.0
28	4.5	8.0	9.0	17.0	20.5	9.8	13.7	7.4	6.0	7.0	9.0	8.8
29	4.5	.....	11.0	17.4	19.5	9.8	13.7	7.0	6.5	6.9	8.8	8.8
30	4.5	.....	10.2	13.7	22.0	9.8	13.7	7.0	6.2	6.7	8.2	8.8
31	4.5	.....	9.9	.....	25.0	.....	13.7	6.7	.....	6.7	.....	8.1

NORTH FORK OF RED RIVER NEAR GRANITE, OKLA.

This station was established June 23, 1903, by Fred Bonstedt. It is located at the highway bridge 2 miles east and one-half mile north of Granite, Okla. The Chicago, Rock Island and Pacific Railway crosses the river near this point.

The channel is straight for about 500 feet above the station and about 300 feet below. Both banks are subject to overflow at flood stages. The bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge.

The original wire gage was replaced December 5, 1905, by a standard chain gage bolted to the fencing on the upstream side of the bridge, 48 feet from the west end. Length of chain, 21.16 feet. During 1905 the gage was read once each day by Elmer O. Tompkins. The bench mark is a United States Geological Survey standard iron post set 292 feet east of the bridge, near the south line of the highway; elevation, 10.64 feet above the datum of the gage and 1,539.8 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 319; 131, pp 182-183.
Discharge: 99, p 319; 131, p 183.
Gage heights: 99, p 320; 131, p 183.

Discharge measurements of North Fork of Red River near Granite, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 24	E. R. Kerby	192	391	3.23	6.50	1,265
April 12	do	32	34	.86	5.40	30
April 26	Murphy and Kerby	268	784	4.26	7.35	3,340
April 26	J. M. Giles	326	1,225	4.39	8.00	5,379
May 23	E. R. Kerby	101	134	1.99	6.10	266
May 24	J. M. Giles	87	76	1.90	5.80	144
June 9	E. R. Kerby	100	138	2.98	6.30	410
July 2	do	30	15	.82	5.50	12
July 11	do	12	11	.58	5.40	6.4
August 24	do	23	13	1.14	5.50	15
August 25	J. M. Giles	16	9.8	1.29	5.45	12.6
September 24	do	14	4.6	.59	5.20	2.7
September 27	E. R. Kerby	2.5	.5	1.00	5.10	.5
November 29	do		86	1.62	6.10	139
December 5	do		53	1.65	5.75	87
December 19	do		45	1.59	6.05	72
([a])	J. M. Giles		2,916	6.24	11.50	18,200
([a])	do		2,100	5.11	9.50	10,730
([a])	do		650	2.32	8.00	1,508
([a])	do		240	1.58	7.00	380

[a] Computed from slope measurement, using Kutter's formula.

Daily gage height, in feet, of North Fork of Red River near Granite, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	5.4	5.2	6.0	6.8	5.6	5.6	5.2	4.9	4.9	5.9
2	.....	.....	5.4	5.3	6.0	.....	5.5	5.5	5.1	5.0	4.9	5.9
3	.....	.....	5.3	5.3	5.9	.....	5.5	5.5	5.1	5.0	4.9	5.85
4	.....	.....	5.2	5.4	5.7	6.1	5.5	6.0	5.1	4.95	4.9	5.8
5	.....	.....	5.3	6.2	5.5	6.0	5.5	5.7	5.0	4.9	4.9	5.75
6	.....	.....	5.9	5.9	5.3	5.9	5.5	5.8	5.4	4.9	4.9	5.85
7	.....	.....	5.5	5.8	5.3	6.4	5.4	5.9	5.2	4.9	4.9	5.85
8	.....	.....	5.4	5.8	5.8	6.2	5.4	6.0	8.5	4.9	4.9	5.85
9	.....	.....	5.6	5.8	6.5	6.4	5.4	6.1	7.6	4.9	.....	5.8
10	.....	.....	5.9	6.3	6.1	6.2	5.4	6.2	7.5	4.9	6.0	5.8
11	.....	.....	5.7	6.1	5.9	6.2	5.3	5.8	6.4	4.9	6.8	5.85
12	.....	.....	5.6	5.8	5.7	6.1	5.3	6.0	6.0	4.9	6.1	5.85
13	.....	.....	5.6	5.6	5.6	6.0	5.3	7.8	6.0	4.9	6.05	6.0
14	.....	.....	5.6	5.4	5.5	6.1	5.3	7.0	6.05	4.9	6.0	6.05
15	.....	.....	5.7	5.4	5.4	6.0	5.3	6.8	5.9	4.9	6.0	6.4
16	.....	.....	5.9	5.4	5.7	5.9	5.4	6.5	5.65	4.9	5.95	6.15
17	.....	.....	7.7	5.3	5.4	5.9	5.4	6.2	5.5	4.9	5.85	6.1
18	.....	.....	6.5	5.3	5.3	5.8	5.4	.....	5.5	4.9	5.8	6.1
19	.....	.....	6.3	5.3	5.3	5.9	5.4	.....	5.45	4.9	.....	6.05
20	.....	.....	6.2	5.7	5.7	5.8	5.3	6.1	5.6	4.9	5.7	6.05
21	.....	.....	5.9	5.6	5.8	5.8	5.5	6.0	5.4	4.9	5.7	6.0
22	.....	.....	5.7	5.6	6.1	5.7	6.1	5.8	5.3	4.9	5.75	6.1
23	.....	8.1	5.6	5.8	6.0	5.6	5.9	5.6	5.2	4.9	5.8	6.15
24	5.0	6.5	5.4	6.2	5.8	5.6	5.6	5.5	5.2	4.9	8.85	.....
25	5.6	5.8	5.2	8.3	5.9	.....	5.5	5.5	5.2	4.9	7.5	.....
26	5.5	5.5	5.5	8.1	6.0	5.8	5.4	5.4	5.2	4.9	6.4	6.25
27	5.5	5.3	5.5	6.6	9.9	5.7	5.4	5.4	5.1	4.9	6.2	6.1
28	5.3	5.6	5.5	6.3	10.2	5.7	5.5	5.4	5.05	4.9	6.0	6.1
29	5.3	.....	5.3	6.0	7.4	5.6	5.6	5.4	5.0	4.9	5.9	6.1
30	5.5	.....	5.2	5.9	6.8	5.6	5.9	5.3	4.95	5.0	5.9	6.1
31	5.4	.....	5.1	.....	7.0	.....	5.7	5.3	.....	4.95	.....	.....

NORTH FORK OF RED RIVER NEAR SNYDER, OKLA.

This station was established April 14, 1905, and was discontinued July 31, 1905. It is located at the Frisco Railway bridge about 8 miles west of Snyder, Okla.

The channel is straight for 300 feet above and 1,000 feet below the station. The current is swift. The right bank is low and sandy, and overflows only under the railway trestle. The left bank is high and rocky and is not subject to overflow. The bed of the stream is composed of sand and is free from vegetation and shifting. There is but one channel, broken only by the pile bents, which are very close together, catching large quantities of drift during floods and making the current varying and uncertain.

Discharge measurements are made from the upstream side of the railroad bridge on trestle bents 14 feet apart. The initial point for soundings is the end of the upstream guard rail at the right bank.

A standard chain gage is attached to the downstream guard rail of the bridge; length of the chain, 18.65 feet. There are also two short sections of vertical gage fastened to the piles of the bridge. During 1905 the gage was read once each day by D. M. Deason. The bench mark is a cross on a rock on the left bank, 200 feet above the bridge; elevation, 7.04 feet above the datum of the gage.

Discharge measurements of North Fork of Red River near Snyder, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	E. R. Kerby	106	183	0.88	2.40	161
April 14	J. M. Giles	477	1,603	1.90	4.05	3,045
May 19	E. R. Kerby	182	224	.63	2.40	142
May 21	J. M. Giles	340	691	1.47	3.25	1,017
May 22	do	399	862	1.90	3.71	1,639
May 25	E. R. Kerby	162	330	1.78	2.90	589
May 30	do	357	2,203	3.43	4.15	7,546
June 1	J. M. Giles	480	1,978	1.58	4.35	3,121
June 13	E. R. Kerby	220	308	1.52	2.37	469
June 27	do	141	189	1.28	1.90	242
July 6	do	130	140	.81	1.50	113
July 7	do	131	146	.83	1.55	122
July 13	do	130	138	.94	1.65	130
July 14	do	130	136	.91	1.60	124
July 16	J. M. Giles	128	116	.69	1.50	80
July 20	do	125	99	.61	1.40	61
July 25	E. R. Kerby	145	200	1.48	2.00	296

Daily gage height, in feet, of North Fork of Red River near Snyder, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1		2.8	4.2	1.9	17	2.3		2.2	1.5
2		2.7	3.9	1.9	18	2.4		2.0	1.5
3			3.2	1.9	19	2.4	2.4	2.0	1.5
4			2.8	1.8	20	2.3	2.7	1.9	1.4
5			2.7	1.7	21	2.7	3.2	1.9	1.4
6			2.6	1.6	22	2.6	3.9	1.9	2.1
7			3.2	1.6	23	3.2	3.5	3.2	2.4
8			3.9	1.6	24	3.2	3.3	2.5	2.0
9			3.8	1.7	25	4.9	2.9	2.1	1.9
10			3.2	1.6	26	4.1	2.5	2.0	1.9
11			2.6	1.7	27	4.1	6.9	1.9	1.8
12		4.3	2.5	1.6	28	3.5	6.6	1.9	1.7
13		4.5	2.4	1.5	29	3.2	5.0	1.8	1.6
14	2.4		2.4	1.5	30	3.1	4.2	1.9	1.5
15	2.3		2.3	1.5	31		4.5		1.2
16	2.3		2.2	1.5					

NORTH FORK OF RED RIVER NEAR HEADRICK, OKLA.

This station was established July 17, 1905. It is located at the Navajo dam site, about 4 miles northeast of Headrick and 8 miles west of Mountain Park, Okla.

The channel is straight for 200 feet above and 1,000 feet below the station. Both banks are high and clean and will not overflow. The bed of the stream is composed of sand and is shifting. There is but one channel at all except very low stages.

Discharge measurements are made by means of a cable and car about 100 yards above the gage. The initial point for soundings is a paint mark on the cable near the right end.

An inclined staff gage is fastened to the rock on the right bank. Above 6 feet the gage is painted on the rock. During 1905 the gage was read once each day by John Graves. The bench mark is a cross cut in the rock about 10 feet south of the gage; elevation, 8.40 feet above the datum of the gage.

Discharge measurements of North Fork of Red River near Headrick, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
July 17	J. M. Giles	49	67	1.00	2.00	67
July 19	do	74	108	.54	1.95	58
July 19	E. R. Kerby	54	59	.92	1.95	54
July 20	J. M. Giles	36	47	1.06	1.92	50
July 25	E. R. Kerby	175	309	2.47	3.10	764
July 26	do	121	202	1.50	2.70	303
July 26	do	118	191	1.46	2.60	278
August 2	do	54	103	1.18	2.20	122
August 2	do	53	96	1.25	2.10	120
August 9	do	52	83	1.10	2.10	91
August 9	do	52	86	1.38	2.15	119
August 14	do	200	619	3.84	4.25	2,380
August 15	do	200	611	3.56	4.20	2,174
August 15	do	200	600	3.54	4.25	2,126
August 15	do	200	618	3.18	4.22	1,965
August 16	do	190	443	2.16	3.72	960
August 19	do	80	295	1.43	3.30	422
August 26	do	95	71	1.18	2.25	84
August 30	do	70	58	1.09	2.10	63
September 5	do	27	41	.61	1.90	25
September 13	do	86	318	1.16	3.10	368
September 13	do	86	310	1.08	3.00	335
September 18	do	83	259	.53	2.50	133
September 20	do	83	274	.71	2.75	196
September 20	do	83	266	.62	2.65	165
September 21	J. M. Giles	84	259	.48	2.60	125
September 29	E. R. Kerby	26	81	.55	2.20	44
October 4	do	26	82	.56	2.20	46
October 4	do	26	82	.59	2.20	48
October 13	do	29	16	1.32	2.10	21
October 22	do	30	20	1.25	2.10	25
October 27	do	20	20	1.10	2.10	22
November 11	do		389	2.78	3.80	1,082
November 13	do		241	1.13	3.00	272
November 24	do		222	1.30	2.80	288
November 27	do		373	1.38	3.20	514
December 8	J. M. Giles		306	.40	2.60	121
December 16	E. R. Kerby		314	.99	3.00	312
December 22	do		264	.86	2.85	226
December 27	do		255	.78	2.70	198

Daily gage height, in feet, of North Fork of Red River near Headrick, Okla., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1	.....	2.8	2.0	2.2	2.1	2.6	17	.....	3.2	2.6	2.1	2.7	2.7
2	.....	2.5	2.0	2.2	2.1	2.6	18	2.0	3.0	2.5	2.1	2.7	2.7
3	.....	2.3	1.9	2.2	2.1	2.6	19	2.0	3.5	2.4	2.1	2.5	2.6
4	.....	2.1	1.9	2.2	2.1	2.6	20	1.9	3.0	2.6	2.1	2.4	2.6
5	.....	2.1	2.1	2.2	3.0	2.6	21	1.8	2.8	2.7	2.1	2.4	2.6
6	.....	2.8	2.2	2.2	2.5	2.6	22	2.5	2.7	2.5	2.1	2.4	2.6
7	.....	2.4	2.2	2.2	2.3	2.6	23	3.0	2.5	2.5	2.1	2.4	2.6
8	.....	2.8	2.3	2.1	2.5	2.6	24	2.6	2.4	2.5	2.1	2.8	2.6
9	.....	2.3	3.6	2.1	3.0	2.6	25	2.5	2.3	2.3	2.1	3.8	2.6
10	.....	2.1	4.45	2.1	3.1	2.6	26	2.8	2.2	2.3	2.1	2.6	2.6
11	.....	2.1	3.7	2.1	3.8	2.5	27	2.4	2.0	2.2	2.1	3.2	2.7
12	.....	2.2	3.5	2.1	3.1	2.5	28	2.3	2.0	2.2	2.1	2.2	2.7
13	.....	2.6	3.1	2.1	3.1	2.7	29	2.3	2.0	2.2	2.1	2.6	2.6
14	.....	4.6	2.9	2.1	2.8	2.7	30	2.4	1.9	2.2	2.1	2.6	2.6
15	.....	4.2	2.8	2.1	2.7	2.7	31	2.8	2.0	.....	2.1	.....	2.6
16	.....	3.7	2.7	2.1	2.7	3.0							

Daily discharge, in second-feet, of North Fork of Red River near Headrick, Okla., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	425	50	46	25	190	17	.....	430	150	24	240	230
2	.....	220	50	46	26	180	18	67	300	130	24	240	230
3	.....	140	30	46	26	170	19	67	720	110	24	160	200
4	.....	80	25	46	26	160	20	50	300	150	24	125	200
5	.....	80	60	43	340	150	21	35	190	175	24	125	200
6	.....	425	75	40	125	140	22	220	155	130	24	125	200
7	.....	180	75	37	75	130	23	630	115	130	24	125	200
8	.....	425	90	31	125	120	24	275	100	130	24	290	190
9	.....	140	840	31	340	120	25	220	85	75	24	1,080	180
10	.....	95	3,300	27	150	120	26	425	75	75	24	200	180
11	.....	95	975	24	1,080	100	27	180	65	50	24	515	190
12	.....	110	720	21	360	100	28	140	65	45	24	75	190
13	.....	275	370	21	360	170	29	140	65	45	24	200	170
14	.....	4,900	270	21	290	170	30	180	62	45	24	200	170
15	.....	2,050	220	24	240	170	31	425	65	.....	24	.....	170
16	.....	970	175	24	240	320							

NOTE.—On account of shifting conditions, the daily discharge has been computed from several rating tables, each covering a short period of time.

Estimated monthly discharge of North Fork of Red River near Headrick, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
July 18–31	630	35	218	6,064
August	4,900	62	432	26,[illegible]
September	3,300	25	292	17,[illegible]
October	46	21	28.6	1,[illegible]
November	1,080	25	251	14,940
December	320	100	175	10,[illegible]
The period	.....	.....	.....	77,430

ELM FORK OF RED RIVER NEAR MANGUM, OKLA.

This station was established April 12, 1905. It is located on the highway bridge about 4 miles north of Mangum, Okla.

The channel is straight for about 500 feet above and 200 feet below the bridge. The current is swift. Both banks are low and liable to overflow. The bed of the stream is composed of sand and is shifting. There is but one channel, broken by the pile bents of the bridge, which catch and hold drift badly during high water.

Discharge measurements are made from the upstream side of the pile bent bridge. The initial point for soundings is at the north end of the bridge.

A standard chain gage is fastened to the bridge; length of chain, 24.58 feet. During 1905 the gage was read once each day by E. R. Pierson. Bench marks were established as follows: (1) An iron pin driven flush with the surface 59 feet south and 7 feet west of the south end of the bridge; elevation, 14.30 feet (2) A paint mark on the top of the bridge cap 10 feet south of the gage; elevation, 18.46 feet. Elevations refer to the datum of the gage.

Discharge measurements of Elm Fork of Red River near Mangum, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 12	E. R. Kerby	40	18	0.72	2.00	13
April 26	Murphy and Kerby	190	248	1.96	3.56	487
May 23	E. R. Kerby	130	105	1.46	2.90	153
May 25	J. M. Giles	242	589	2.28	4.70	1,346
May 25	do	143	145	1.26	2.90	183
May 26	do	151	167	1.55	3.30	259
May 26	do	226	321	1.84	3.88	592
May 27	do	310	1,404	4.74	8.35	6,648
May 27	do	312	1,722	5.38	9.30	9,271
June 22	E. R. Kerby	276	581	3.08	5.40	1,791
July 2	do	53	34	1.48	2.60	49
July 11	do	62	52	1.46	2.80	76
July 11	do	62	46	1.40	2.70	64
July 25	J. M. Giles	98	102	1.53	3.16	156
August 24	E. R. Kerby	53	21	1.15	2.40	24
September 24	J. M. Giles	42	16	.87	2.30	14
September 27	E. R. Kerby	32	14	1.14	2.30	16
October 25	do	32	14	1.17	2.30	16
November 29	do		33	1.33	2.40	44
December 5	do		35	1.20	2.30	43
December 19	do		24	1.09	2.40	26
(a)	J. M. Giles		893	2.43	5.40	2,175
(a)	do		3,000	480	11.50	14,400

[a] Computed from slope measurement, using Kutter's formula.

Daily gage height, in feet, of Elm Fork of Red River near Mangum, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.4	3.7	2.6	2.5	2.3	2.2	2.4	2.3
2	.....	2.3	3.2	2.6	2.5	2.3	2.2	2.3	2.3
3	.....	2.2	3.2	2.6	2.5	2.3	2.2	2.3	2.3
4	.....	2.2	3.0	2.6	3.0	2.3	2.2	2.3	2.4
5	.....	2.2	3.0	2.6	2.6	2.3	2.3	3.0	2.3
6	.....	2.2	2.9	2.5	2.5	2.4	2.3	2.6	2.3
7	.....	2.3	5.9	2.5	2.7	2.4	2.3	2.7	2.3
8	.....	2.3	4.5	2.5	3.1	2.4	2.3	2.6	2.3
9	.....	2.3	3.5	2.5	2.6	3.0	2.3	4.2	2.3
10	.....	2.5	3.0	2.7	2.5	3.4	2.3	4.4	2.3
11	.....	2.3	3.0	2.7	2.5	2.8	2.3	2.9	2.3
12	2.0	2.3	2.9	2.6	2.4	2.5	2.3	2.7	2.3
13	2.0	3.5	2.8	2.5	3.9	2.5	2.2	2.5	2.9
14	1.9	3.2	2.9	2.5	4.8	2.5	2.2	2.4	2.5
15	1.8	2.5	2.8	2.5	3.2	2.4	2.2	2.4	2.5
16	1.9	2.2	2.8	2.5	2.8	2.4	2.2	2.4	2.4
17	2.0	2.1	2.7	2.4	2.7	2.3	2.3	2.4	2.4
18	2.2	2.0	2.7	2.4	2.6	2.3	2.3	2.3	2.4
19	2.9	2.2	2.7	2.6	2.5	3.2	2.2	2.3	2.4
20	2.5	2.9	2.7	2.4	2.5	2.4	2.2	2.3	2.4
21	2.3	3.9	2.6	2.4	2.4	2.4	2.2	2.4	2.4
22	2.1	3.7	5.6	3.2	2.4	2.3	2.2	2.3	2.4
23	2.1	3.0	3.7	2.7	2.4	2.3	2.2	2.5	2.5
24	4.7	2.6	3.1	4.2	2.4	2.3	2.2	4.6	2.5
25	5.4	4.0	2.9	3.4	2.3	2.3	2.2	3.2	2.4
26	3.6	3.9	2.6	2.8	2.3	2.3	2.2	2.7	2.4
27	2.9	11.6	2.6	2.7	2.3	2.3	2.2	2.5	2.4
28	2.6	4.9	2.7	2.6	2.3	2.3	2.2	2.4	2.4
29	2.4	3.7	2.6	3.0	2.3	2.2	2.2	2.4	2.4
30	2.6	3.5	2.6	2.9	2.3	2.2	2.3	2.4	2.4
31	.....	5.1	.....	2.6	2.3	.....	2.3	.....	.....

Daily discharge, in second feet, of Elm Fork of Red River near Mangum, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	65	550	50	37	14	9	25	41
2	.....	50	260	50	37	14	9	16	41
3	.....	37	260	50	37	14	9	16	41
4	.....	37	195	50	120	14	9	16	41
5	.....	37	195	50	50	14	16	120	41
6	.....	37	165	37	37	25	16	50	41
7	.....	50	2,500	37	65	25	16	65	41
8	.....	50	1,150	37	140	25	16	50	41
9	.....	300	400	37	50	120	16	900	41
10	.....	80	195	65	37	225	16	1,100	41
11	.....	50	195	65	37	80	16	100	41
12	16	50	165	50	25	37	16	65	41
13	16	400	140	37	680	37	9	37	120
14	10	260	165	37	1,400	37	9	25	90
15	7	80	140	37	165	25	9	25	23
16	10	37	140	37	80	25	9	25	20
17	16	26	120	25	65	14	16	25	20
18	37	16	120	25	50	14	16	16	20
19	165	37	120	50	37	165	9	16	20
20	82	165	120	25	37	25	9	16	20
21	50	680	100	25	25	25	9	25	20
22	26	550	2,150	165	25	14	9	16	20
23	26	195	550	65	25	14	9	37	23
24	1,350	100	225	900	25	14	9	1,250	23
25	1,850	750	165	350	14	14	9	200	20
26	500	680	100	80	14	14	9	92	20
27	165	14,600	100	65	14	14	9	58	20
28	100	1,500	120	50	14	14	9	48	20
29	65	550	100	120	14	7	9	44	20
30	100	400	100	100	14	7	16	44	20
31	.....	1,700	.....	50	14	.....	16	.....	20

NOTE.—On account of shifting conditions the low-water discharge was computed from several rating tables. The high-water discharge was computed from current-meter and slope measurements.

Estimated monthly discharge of Elm Fork of Red River near Mangum, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 12-30	1,850	7	242	9,120
May	14,600	16	760	46,730
June	2,500	100	367	21,840
July	900	25	91.0	5,595
August	1,400	14	109	6,702
September	225	7	36.2	2,154
October	16	9	11.7	719
November	1,250	16	151.	8,985
December	120	20	33.9	2,084
The period	.....	.....	.....	103,900

ELK CREEK NEAR HOBART, OKLA.

This station was established April 13, 1905. It is located at the highway bridge about 7 miles south of Hobart, Okla. The station 3 miles southwest of Hobart, established September 22, 1904, was continued until this station was established. The 1905 gage heights at the old station have been referred to the datum of the new one by adding 0.4 foot.

The channel is straight for 200 feet above and 100 feet below the station. The current is swift and is oblique to the bridge. Both banks are high and wooded. The right bank overflows during extreme high water. The bed of the stream is composed of sand and gravel with very little vegetation and is slightly shifting. There is one channel at all stages up to 20 feet, and two channels at higher stages.

Discharge measurements are made from the downstream side of the bridge. The initial point is at the east end of the bridge, marked with paint.

A standard chain gage is fastened to the bridge; length of chain, 33.45 feet. During 1905 the gage was read once each day by G. W. Hines. Bench marks were established as follows: (1) A standard bench-mark post three-fourths of a mile east of the bridge, 1,459.00 feet above mean sea level and 28.44 feet above the datum of the gage. (2) A paint mark on the downstream end of a bridge beam near the center of the bridge, 1,459.14 feet above mean sea level and 28.58 feet above the datum of the gage.

Discharge measurements of Elk Creek near Hobart, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 29	E. R. Kerby	16	14	0.71	2.00	10
February 24	Whittington and Kerby	16	33	1.02	2.90	34
April 13	E. R. Kerby	20	9.5	2.43	2.30	23
April 26	J. M. Giles	21	75	2.66	5.60	200
April 27	Murphy and Kerby	19.5	30	2.22	3.76	67
May 23	J. M. Giles	17	21	1.81	3.00	39
May 31	do	33	148	2.69	8.57	398
May 31	do	33	151	2.68	8.65	403
July 7	E. R. Kerby	17	11	2.11	2.50	23
July 12	do	16	11	2.00	2.50	22
July 26	J. M. Giles	14	11	2.00	2.55	21
July 26	do	16	10	1.99	2.52	20
August 3	E. R. Kerby	14	8	1.50	2.25	12
August 25	do	14	8	1.75	2.30	13
September 14	do	17	14	1.80	2.65	25
September 19	do	16	8	1.63	2.30	13
September 23	J. M. Giles	18	13	.85	2.25	11
September 28	E. R. Kerby	15	7	1.66	2.20	11
October 14	do	11	4.2	1.48	2.10	6
October 26	do	11	4.2	1.47	2.20	6
November 28	do	.....	13	1.39	2.50	18
December 28	do	.....	14	1.25	2.50	17

Daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.3	2.2	2.2	3.1	10.9	2.7	2.2	2.2	2.2	2.2	2.3
2	2.3	2.3	2.2	2.2	2.5	5.3	2.7	2.3	2.2	2.2	2.2	2.3
3	2.3	2.3	2.2	2.4	2.3	4.2	2.7	2.3	2.3	2.2	2.2	2.3
4	2.3	2.3	2.2	2.4	2.3	4.3	2.6	2.2	2.2	2.2	2.7	2.3
5	2.3	2.3	2.3	2.4	2.2	4.1	2.6	2.2	2.2	2.2	2.4	2.3
6	2.3	2.3	6.4	2.4	2.1	4.2	2.5	2.2	2.2	2.2	2.4	2.3
7	2.3	2.3	4.4	2.3	2.1	4.1	2.5	2.3	2.2	2.2	2.8	2.3
8	2.3	2.3	3.1	2.2	2.2	8.5	2.6	2.3	2.6	2.2	2.5	2.3
9	2.3	2.3	2.8	2.2	2.2	4.6	2.7	2.3	10.1	2.2	2.5	2.4
10	2.3	2.3	2.6	7.9	3.2	4.2	3.9	2.2	7.0	2.2	2.4	2.4
11	2.5	2.3	2.4	3.4	2.2	3.9	3.2	2.2	3.9	2.2	2.3	2.4
12	2.5	2.3	2.3	2.8	2.4	3.4	2.9	2.2	3.0	2.1	2.3	2.4
13	2.5	2.3	2.3	2.3	2.2	3.5	2.8	2.2	2.8	2.1	2.3	2.5
14	2.5	2.3	2.3	2.3	3.0	3.4	2.7	8.2	2.7	2.1	2.3	2.5
15	2.5	2.3	2.2	2.2	2.5	3.4	2.5	13.5	2.6	2.1	2.3	2.5
16	2.5	2.3	2.5	2.1	3.0	3.3	2.4	5.4	2.5	2.1	2.3	2.6
17	2.5	2.4	2.9	2.0	2.1	3.3	2.4	3.4	2.5	2.2	2.3	2.6
18	2.5	2.4	7.1	2.2	2.1	3.1	2.3	3.3	2.5	2.2	2.3	2.6
19	2.5	2.4	5.9	2.2	2.0	3.1	2.3	2.9	2.3	2.2	2.3	2.5
20	2.5	2.4	4.4	2.1	2.0	3.0	2.3	2.8	2.3	2.2	2.3	2.5
21	2.5	2.4	3.5	2.0	4.2	3.0	2.2	2.6	2.3	2.1	2.3	2.5
22	2.5	2.4	3.0	2.0	3.9	3.0	4.3	2.5	2.3	2.1	2.3	2.5
23	2.4	4.4	2.6	2.1	2.6	2.9	4.0	2.4	2.2	2.1	3.4	2.5
24	2.4	3.4	2.4	6.2	2.3	2.9	3.4	2.4	2.2	2.2	3.4	2.5
25	2.4	3.0	2.3	13.2	2.3	2.8	2.9	2.3	2.2	2.2	3.3	2.5
26	2.4	2.4	2.3	8.1	7.0	2.8	2.5	2.3	2.2	2.2	3.3	2.5
27	2.4	2.4	2.3	3.6	16.5	2.8	2.4	2.3	2.2	2.2	2.5	2.5
28	2.4	2.2	2.2	3.0	24.2	2.7	2.3	2.2	2.2	2.3	2.5	2.6
29	2.4	.....	2.2	2.7	21.9	2.7	2.2	2.2	2.2	2.3	2.4	2.6
30	2.3	.....	2.1	3.3	6.4	2.7	2.2	2.2	2.2	2.3	2.4	2.6
31	2.3	.....	2.2	.....	9.2	.....	2.2	2.2	.....	2.3	.....	2.6

OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 2, 1903, by G. H. Matthes. It is located on G. M. Dale's homestead, in the SE. ¼ sec. 21, T. 3 N., R. 17 W. of the Indian meridian. It is 2 miles west and 1 mile north of Mountain Park, Okla.

The channel is slightly curved both above and below the station. Both banks are about 20 feet high, of sandy loam, covered with vegetation, and subject to overflow. The bed of the stream is of sand and is liable to shift. The water flows in one channel at normal stages, but when about to overflow its banks part of the water is diverted through a slough into Horse Creek.

Discharge measurements are made by wading at low stage and from a cable about 100 yards below the gage at ordinary and flood stages.

The gage is a staff fastened to a cottonwood tree which stands at the water's edge. During 1905 the gage was read once each day by G. M. Dale. Bench marks were established as follows: (1) A 20-penny nail driven into the cottonwood tree to which the gage is attached; elevation, 10.00 feet. (2) A nail driven into a mesquite tree 150 feet southwest of G. M. Dale's house; elevation, 28.62 feet. (3) A nail driven into a hackberry tree 50 feet east of the creek and 20 feet north of the gage; elevation, 8.94 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 316-317; 131, p 185.
Discharge: 99, p 317; 131, p 185.
Discharge, monthly: 99, p 319; 131, p 187.
Gage heights: 99, 317-318; 131, p 186.
Rating table: 99, p, 318

Discharge measurements of Otter Creek near Mountain Park, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*[a]
January 30	E. R. Kerby	5	0.75	1.00	1.00	0.75
February 25	do	7	2.5	.80	1.20	2.0
April 19	do	9	4	1.35	1.20	5.4
May 13	do	61	746	2.37	13.30	1,772
May 14	do	29	71	1.86	3.30	133
May 17	do	19	18	1.38	1.70	25
May 20	Kerby and Osburne	54	448	2.97	11.00	1,332
May 22	J. M. Giles	53	364	1.53	6.50	556
May 24	E. R. Kerby	18	22	1.84	2.00	39
May 31	do	52	409	1.79	7.40	732
June 1	J. M. Giles	33	95	1.36	2.95	129
June 28	E. R. Kerby	19	7	1.20	1.20	8
July 6	do	15	5	.86	1.20	4.3
July 6	do	6	3.7	1.16	1.20	4.3
July 8	do	13	4.5	1.20	1.25	5.4
July 13	do	12	5.4	.91	1.20	5.0
July 15	do	12	5.4	1.00	1.25	5.4
July 15	J. M. Giles	12	4.0	.86	1.20	3.4
July 19	E. R. Kerby	12	4.0	.75	1.15	3.0
July 20	do	12	5	.76	1.20	3.8
July 21	J. M. Giles	5	2.9	.82	1.15	2.4
July 22	do	23	14	1.35	1.62	19
July 24	E. R. Kerby	18	13.5	1.41	1.50	19
July 26	do	12	5.1	1.08	1.20	5.6
July 27	do	12	5.2	1.12	1.20	5.8
August 3	do	10	2.9	1.08	1.15	3.1
August 8	do	7	3.9	.67	1.10	2.6
August 10	do	7	4.4	.70	1.10	3.1
August 20	do	5.5	1.7	1.05	1.10	1.8
August 27	do	5	1.4	.94	1.00	1.3
August 29	do	5	2.1	.28	1.0	.6
September 4	do	3	.6	1.00	.95	.6
September 12	do	5.5	1.5	.90	1.20	1.4
September 15	do	5.5	1.5	.87	1.15	1.3
September 18	do	3	.6	1.00	1.10	[a].6
September 21	J. M. Giles	1.6	.3	.65	1.00	2
September 29	E. R. Kerby	3	.6	1.00	1.00	[a].6
October 3	do	3	.6	1.00	1.00	[a].6
October 5	do	3	.6	1.00	1.00	[a].6
October 12	do	3	.6	1.00	1.00	.6
October 15	do	3	.6	1.00	1.00	[a].6
October 21	do	3	.6	1.00	1.00	[a].6
November 11	do	27	16	.81	1.60	13
November 12	do	27	15	.80	1.50	12
November 24	do	10	6	1.00	1.40	6

[a] Float measurement.

Daily gage height, in feet, of Otter Creek near Mountain Park, Okla, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	1.1	1.1	5.2	1.6	3.0	1.4	1.1	1.0	1.0	1.1	1.2
2	.9	1.1	1.1	3.8	1.5	2.4	1.3	1.1	1.0	1.1	1.1	1.2
3	.9	1.1	1.1	2.0	1.5	2.0	1.2	1.2	1.0	1.1	1.1	1.2
4	.9	1.1	1.1	1.6	1.5	1.8	1.2	1.3	1.0	1.1	1.2	1.1
5	.9	1.1	1.1	1.5	1.4	1.7	1.2	1.2	1.0	1.1	1.9	1.1
6	.9	1.1	1.1	1.7	1.4	1.5	1.2	1.2	1.1	1.1	1.5	1.1
7	.9	1.1	1.3	1.5	1.4	1.5	1.2	1.2	1.1	1.1	1.3	1.1
8	.9	1.1	1.3	1.3	1.4	1.5	1.2	1.2	1.1	1.1	1.3	1.1
9	1.0	1.1	1.3	1.3	1.45	1.5	2.0	1.1	1.3	1.1	2.5	1.1
10	1.0	1.2	1.2	1.2	1.5	1.5	1.5	1.1	1.2	1.1	2.5	1.1
11	1.0	1.2	1.2	1.1	5.0	1.5	1.3	1.1	1.2	1.1	1.8	1.1
12	1.0	1.2	1.2	1.1	12.0	1.5	1.3	1.1	1.2	1.1	1.4	1.1
13	1.0	1.1	1.1	1.1	13.1	1.5	1.3	2.9	1.2	1.0	1.3	1.4
14	1.0	1.1	1.1	1.0	4.1	1.4	1.2	1.8	1.2	1.0	1.3	1.3
15	1.0	1.1	1.8	1.0	2.4	1.4	1.2	1.5	1.2	1.0	1.2	1.3
16	1.0	1.1	2.15	1.0	1.9	1.4	1.2	1.3	1.2	1.0	1.2	1.3
17	1.1	1.2	2.45	1.0	1.7	1.4	1.2	1.2	1.1	1.0	1.2	1.3
18	1.2	1.3	2.6	1.2	1.6	1.4	1.2	1.2	1.1	1.0	1.2	1.2
19	1.1	1.3	1.7	1.2	1.6	1.3	1.2	1.1	1.1	1.0	1.1	1.2
20	1.1	1.3	1.4	1.2	8.4	1.3	1.2	1.1	1.1	1.0	1.2	1.2
21	1.1	1.2	1.2	1.1	4.8	1.3	1.1	1.1	1.1	1.0	1.2	1.2
22	1.1	1.2	1.2	1.1	5.9	1.3	2.4	1.1	1.0	1.0	1.2	1.2
23	1.0	1.2	1.1	2.7	3.0	1.3	1.5	1.1	1.0	1.0	1.2	1.2
24	1.0	1.3	1.1	7.8	2.3	1.3	1.5	1.1	1.0	1.1	1.3	1.2
25	1.0	1.2	1.1	14.0	2.3	1.3	1.3	1.0	1.0	1.1	1.3	1.2
26	1.0	1.2	1.1	5.0	2.6	1.3	1.3	1.0	1.0	1.1	1.2	1.2
27	1.0	1.1	1.1	2.8	19.3	1.3	1.2	1.0	1.0	1.1	1.2	1.2
28	1.0	1.1	1.1	2.1	6.0	1.2	1.2	1.0	1.0	1.1	1.2	1.2
29	1.0	.....	1.2	1.8	3.2	1.2	1.1	1.0	1.0	1.1	1.2	1.2
30	1.0	.....	1.1	1.7	8.3	1.2	1.1	1.0	1.0	1.1	1.2	1.2
31	1.1	.....	1.1	.....	6.5	.....	1.1	1.0	.....	1.1	.....	1.2

Daily discharge in second-feet, of Otter Creek near Mountain Park, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	384	24	120	14	3	0.6	0.6	1	2
2	208	20	64	10	3	.6	1	1	2
3	37	19	37	5	4	.6	1	1	2
4	28	19	37	5	6	.6	1	3	1
5	23	13	32	4	4	.6	1	30	1
6	33	13	21	5	4	1	1	10	1
7	23	13	21	6	4	1	1	4	1
8	13	13	21	4	4	1	1	4	1
9	13	15	21	37	3	3	1	72	1
10	9	17	21	15	3	2	1	72	1
11	6	357	21	7	3	2	1	24	1
12	6	1,525	21	7	3	1	1	8	1
13	6	1,730	21	8	110	1	.6	5	6
14	3	243	16	5	28	2	.6	5	4
15	4	64	16	4	13	2	.6	3	4
16	3	36	16	3	6	2	.6	3	4
17	4	25	16	4	3	.6	.6	3	4
18	9	20	16	3	3	.6	.6	3	2
19	9	20	12	4	2	.6	.6	1	2
20	9	880	12	4	2	.6	.6	3	2
21	6	330	12	2	2	.6	.6	2	2
22	6	480	12	64	2	.3	.6	2	2
23	90	120	12	16	2	.4	.6	2	2
24	775	56	12	19	2	.5	1	4	2
25	1,900	56	12	9	1	.5	1	4	2
26	357	80	12	9	1	.5	1	2	2
27	100	2,910	12	7	1	.6	1	2	2
28	43	495	8	6	.8	.6	1	2	2
29	36	141	8	4	.6	.6	1	2	2
30	30	860	7	3	.6	.6	1	2	2
31	.....	570	.....	3	.6	.....	1	.....	2

NOTE.—The daily discharge was obtained by indirect method. As no measurements were made prior to April 1 no estimates were made for that period.

Estimated monthly discharge of Otter Creek near Mountain Park, Okla., for 1905.

[Drainage area, 126 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	1,900	3	139	8,271	1.10	1.23
May	2,910	13	360	22,140	2.86	3.30
June	120	7	22.3	1,327	.177	.198
July	64	2	9.5	584	.075	.086
August	110	.6	7.2	443	.057	.066
September	3	.3	.95	57	.0075	.0084
October	1	.6	.85	52	.0067	.0077
November	72	1	9.3	553	.074	.083
December	6	1	2.1	129	.017	.020
The period	.....	.....	.....	33,560	.....	.....

HORSE CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 17, 1905. It is located 5 miles north of Mountain Park, in the SE. ¼ sec. 1, T. 3 N., R. 17 W., of the Indian meridian.

The channel is straight for 50 feet above and 200 feet below the station. The current is sluggish. Both banks are low, covered with grass and weeds, and subject to overflow during high water. The bed of the stream is composed of firm earth, covered with vegetation, and is fairly permanent. There is but one channel.

Discharge measurements are made by wading near the gage. At high water measurements are made by means of a boat.

The gage is a staff with an auxiliary gage 600 feet downstream from the regular gage, for determining the slope of the stream. During 1905 the gage was read once each day by John S. Cundiff, when the stream was flowing. The bench mark is a nail driven into the elm tree to which the gage is fastened; elevation, 5.65 feet above the datum of the gage.

Discharge measurements of Horse Creek near Mountain Park, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 28	Murphy and Giles	3.3	1.33	0.54	0.71	0.72
May 14	E. R. Kerby	5	5.8	1.16	1.60	6.7
May 20	J. M. Giles	16	30	.86	2.95	26.3
July 6	E. R. Kerby				.40	0
November 24	do		.8	.67	.60	.54
([a])	J. M. Giles		90	2.30	5.00	207

[a] Computed from slope measurement using Kutter's formula.

Daily gage height, in feet, of Horse Creek near Mountain Park, Okla. for 1905.

Day.	Apr.	May.	June.	July.	Dec.	Day.	Apr.	May.	June.	July.	Dec.
1		0.5	1.3	0.7		17		0.7			0.4
2		.5	1.0			18	0.9	.7			.4
3		.5	.8			19	1.0	.6			.4
4		.4	.7			20	.8	5.4			.4
5		.4	.7			21	.5	3.2			.4
6		.4	.7			22	.5	3.0			.4
7		.4	.7			23	6.0	1.3			.4
8			.7			24	2.4	.9			.4
9			.6	1.5		25	3.0	1.7			.4
10		.6	.6			26	1.3	1.2			.4
11		2.9	.7			27	.8	7.0			.4
12		5.5	.7			28	.7	2.1			.4
13		6.0	.5			29	.6	1.2			.4
14		1.6				30	.5	4.8			.4
15		1.0				31		2.7			
16		.8									

DRY FORK OF OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 18, 1905. It is located about 4 miles northeast of Mountain Park, Okla., in sec. 15, T. 3 N., R. 16 W., of the Indian meridian.

The channel is straight for 200 feet above and below the station. The current is swift. The left bank is high; the right is low. Both are wooded and subject to overflow. The bed is sand and gravel, free from vegetation and slightly shifting. There is but one channel.

Discharge measurements are made by wading near the gage.

The gage is a staff with an auxiliary gage 500 feet upstream from the regular gage for determining the slope. During 1905 the gage was read once each day by A. B. Slaybaugh. The bench mark is a nail driven into a leaning cottonwood tree near a pump 35 feet upstream from the gage; elevation, 6.53 feet above the datum of the gage.

Discharge measurements of Dry Fork of Otter Creek near Mountain Park, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 18	E. R. Kerby	8	3	1.35	0.80	4
April 28	Murphy and Giles	9	5	1.65	.90	8
May 14	E. R. Kerby	14	14	2.04	1.50	28
May 20	J. M. Giles	28	22	1.06	1.40	23
June 12	E. R. Kerby	9	4	1.17	.70	4
July 13	do	4	1.2	.83	.40	1
July 15	J. M. Giles	6	2.2	.28	.45	.6
August 8	E. R. Kerby	1	.5	1.00	.40	.5
November 24	do		2.6	.96	.80	2.5
December 15	do		1.8	1.33	.60	2.4
December 29	do		1.5	1.20	.50	1.8
(a)	J. M. Giles		104	3.43	4.00	357
(a)	do		139	3.88	5.00	539
(a)	do	75	268	5.05	8.00	1,353

[a] Computed from slope measurements, using Kutter's formula.

Daily gage height, in feet, of Dry Fork of Otter Creek near Mountain Park, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.7	1.1	0.7	0.4	.....	.....	0.4	0.4
2	.....	.7	1.0	.6	.4	.....	.....	.4	.4
3	.....	.7	1.0	.5	.8	.....	0.3	.4	.4
4	.....	.6	.8	.5	.5	.....	.3	.5	.4
5	.....	.6	.8	.5	.4	.....	.3	.5	.4
6	.....	.6	.7	.5	.4	.....	.3	.6	.4
7	.....	.5	.7	.5	.4	.....	.3	.6	.4
8	.....	.5	.7	.5	.4	0.8	.3	.6	.4
9	.....	.5	.7	.7	.4	.5	.3	.7	.4
10	.....	2.8	.7	.6	.4	.5	.3	.6	.4
11	.....	2.2	.8	.5	.4	.5	.....	.6	.4
12	.....	5.5	.7	.5	.4	.4	.....	.5	.4
13	.....	8.4	.7	.4	.9	.4	.....	.5	.7
14	.....	1.7	.7	.4	.7	.3	.....	.5	.6
15	.....	1.4	.6	.5	.5	.3	.....	.4	.6
16	.....	1.0	.6	.5	.4	.3	.....	.4	.5
17	.....	.9	.6	.4	.4	.3	.....	.4	.5
18	.....	.9	.6	.4	.4	.3	.....	.4	.5
19	0.7	.8	.6	.4	.4	.3	.....	.4	.4
20	.6	2.5	.6	.4	.4	.3	.....	.4	.4
21	.6	2.3	.6	.5	.4	.3	.....	.4	.4
22	.5	1.9	.6	.5	.3	.3	.....	.4	.5
23	2.0	1.2	.6	.7	.....	.3	.3	.5	.4
24	1.4	1.1	.5	.5	.....	.3	.4	.8	.4
25	2.8	1.2	.5	.5	.....	.3	.4	.6	.4
26	1.4	3.0	.5	.5	.....	.3	.4	.5	.4
27	1.1	5.1	.5	.4	.....	.3	.3	.5	.4
28	.9	1.3	.5	.4	.....	.3	.3	.5	.4
29	.8	1.2	.5	.4	.....	.....	.3	.5	.3
30	.7	1.4	.5	.4	.....	.....	.3	.5	.4
31	.....	1.3	.....	.4	.....	.....	.4	.....	.4

NOTE.—Creek dry August 23 to September 7, September 29 to October 2, and October 11-22, inclusive.

Station rating table for Dry Fork of Otter Creek near Mountain Park, Okla., from April 19 to October 10, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	0.2	1.50	29	2.70	157	3.90	343
.40	.4	1.60	36	2.80	171	4.00	360
.50	1.0	1.70	44	2.90	185	4.20	394
.60	2.0	1.80	53	3.00	200	4.40	429
.70	3.5	1.90	63	3.10	215	4.60	465
.80	5.4	2.00	73	3.20	230	4.80	501
.90	7.8	2.10	84	3.30	245	5.00	539
1.00	10	2.20	95	3.40	261	5.20	577
1.10	13	2.30	106	3.50	277	5.40	616
1.20	16	2.40	118	3.60	293		
1.30	20	2.50	130	3.70	309		
1.40	24	2.60	143	3.80	326		

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during the first part of 1905. It is well defined between gage heights 0.4 foot and 1.5 feet. Above 1.5 feet the rating curve is based on computations from three slope measurements, using Kutter's formula. This extension should be considered only roughly approximate. Owing to shifting conditions a second table applies subsequent to October 10.

Station rating table for Dry Fork of Otter Creek near Mountain Park, Okla., from October 11 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	0.1	0.50	0.6	0.70	1.6
.40	.3	.60	1.0	.80	2.4

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905. It is well defined.

Estimated monthly discharge of Dry Fork of Otter Creek near Mountain Park, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 19-30	171	1.0	27.5	654
May	1,500	1.0	119	7,317
June	13	1.0	3.4	202
July	3.5	.4	1.1	68
August	7.8	.0	.82	50
September	5.4	.0	.41	24
October	.3	.0	.11	6.8
November	2.4	.3	.66	40
December	1.6	.1	.42	26
The period				8,388

SALT FORK OF RED RIVER AT MANGUM, OKLA.

This station was established April 11, 1905. It is located at the highway bridge one-half mile south of Mangum, Okla.

The channel is straight for 1,000 feet above and 2,000 feet below the station. The current is swift. Both banks are low, clean, and sandy, but do not overflow except under the bridge. The bed of the stream is composed of sand and is shifting. There is but one channel broken only by the pile supports of the bridge.

Discharge measurements are made by wading during low water, and from the bridge during high water. The bridge consists of ten 40-foot steel spans on piles, which catch drift during flood stages. The initial point for soundings is the north end of the bridge.

A standard chain gage is fastened to the downstream railing of the bridge; length of chain, 19.54 feet. During 1905 the gage was read once each day by C. O. Bowles. Bench marks were established as follows: (1) An iron post driven flush with the surface on the west side of the road near a mesquite shrub just south of the cut for the highway and about 200 feet from the left bank of the stream; elevation, 12.46 feet. (2) A paint mark on the cross-beam plate on the same side of the bridge as the gage; elevation, 14.30 feet. Elevations refer to the datum of the gage.

Discharge measurements of Salt Fork of Red River at Mangum, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 11	E. R. Kerby	43	20	.70	2.80	14
April 26	Murphy and Kerby	112	323	2.30	3.43	741
May 23	E. R. Kerby	138	133	1.67	3.00	222
May 25	J. M. Giles	202	174	1.62	3.18	281
May 25	do	206	288	2.33	3.40	672
May 26	do	110	79	1.32	2.90	104
May 27	do	415	2,218	6.33	9.00	14,040
June 10	E. R. Kerby	83	78	1.71	1.90	134
July 11	do	148	88	1.58	2.10	139
July 25	J. M. Giles	126	114	2.10	2.33	239
August 24	E. R. Kerby				1.50	[a] 1
September 24	J. M. Giles	8	3	.60	1.30	2
September 27	E R. Kerby	4	.5	1.00	1.30	.5
November 29	do		62	1.29	2.20	80
December 5	do		63	1.29	2.20	81
December 19	do		56	1.16	2.50	66
([b])	J. M. Giles		1,276	6.78	7.50	8,590
([b])	do		833	5.05	6.00	4,210

([a]) Estimated.
([b]) Computed from slope measurement using Kutter's formula.

Daily gage height, in feet, of Salt Fork of Red River at Mangum, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
1	.....	2.5	2.4	.....	2.0	.....	.....	2.2
2	.....	.....	2.4	.....	2.0	.....	.....	2.2
3	.....	.....	.....	.....	2.35	.....	.....	2.2
4	.....	.....	.....	.....	2.1	.....	1.8	2.2
5	.....	.....	.....	.....	2.0	.....	1.9	2.2
6	.....	.....	.....	.....	2.5	2.3	1.8	2.2
7	.....	.....	3.2	.....	1.9	2.0	1.7	2.2
8	.....	.....	2.3	.....	3.0	2.0	1.7	2.2
9	.....	.....	2.2	2.5	2.0	1.9	1.7	2.2
10	.....	.....	2.2	2.2	1.9	1.7	3.0	2.2
11	2.8	.....	2.6	2.0	1.8	1.7	2.6	2.2
12	2.6	.....	2.2	1.8	1.7	1.7	2.5	2.2
13	2.5	.....	2.2	.....	3.8	1.7	2.4	2.6
14	2.4	.....	2.0	.....	2.7	1.6	2.4	2.6
15	.....	.....	2.0	.....	2.3	1.6	2.4	2.5
16	.....	.....	2.0	.....	2.1	1.5	2.3	2.5
17	.....	.....	1.9	.....	2.0	.....	2.2	2.5
18	3.5	.....	1.9	.....	1.8	.....	2.2	2.4
19	3.55	.....	1.8	.....	1.6	.....	2.2	2.3
20	.....	3.2	1.7	.....	.....	.....	2.2	2.2
21	.....	3.3	1.6	.....	.....	.....	2.1	2.2
22	.....	3.3	2.4	.....	.....	.....	2.1	2.5
23	.....	2.9	2.1	2.5	.....	.....	2.4	2.7
24	6.2	.....	2.0	2.9	.....	.....	3.9	2.9
25	3.3	3.2	.....	2.5	.....	.....	3.0	2.7
26	3.1	2.9	.....	2.2	.....	.....	2.4	2.5
27	2.8	7.5	.....	2.5	.....	.....	2.4	2.5
28	2.8	.....	.....	2.2	.....	.....	2.3	2.5
29	2.6	3.0	.....	2.2	.....	.....	2.2	2.5
30	2.5	2.9	.....	2.1	.....	.....	2.2	2.5
31	.....	2.7	.....	2.0	.....	.....	.....	2.5

NOTE.—No flow for missing gage heights; water standing in pools.

Daily discharge, in second-feet, of Salt Fork of Red River at Mangum, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5	360	0	115	0	0	0	82
2		0	360	0	115	0	0	0	84
3		0	0	0	255	0	0	0	85
4		0	0	0	150	0	0	5	85
5		0	0	0	115	0	0	10	85
6		0	0	0	325	180	0	5	85
7		0	725	0	80	110	0	2	85
8		0	315	0	620	110	0	2	85
9		0	270	325	120	75	0	2	85
10		0	270	185	80	30	0	475	85
11	18	0	420	115	50	30	0	240	85
12	10	0	270	50	30	30	0	200	85
13	5	0	270	0	1,240	30	0	160	120
14	2	0	175	0	440	10	0	160	110
15	0	0	175	0	230	10	0	160	80
16	0	0	175	0	150	1	0	120	75
17	0	0	135	0	115	0	0	85	70
18	825	0	135	0	50	0	0	85	40
19	880	0	100	0	10	0	0	85	30
20	0	450	70	0	0	0	0	85	20
21	0	620	50	0	0	0	0	60	20
22	0	620	270	0	0	0	0	60	70
23	0	110	220	325	0	0	0	150	160
24	4,900	100	175	555	0	0	0	1,250	260
25	620	450	0	325	0	0	0	475	160
26	330	110	0	185	0	0	0	160	70
27	20	8,600	0	325	0	0	0	150	70
28	20	600	0	185	0	0	0	110	70
29	10	725	0	185	0	0	0	80	70
30	5	670	0	150	0	0	0	80	70
31		540		115	0		0		70

NOTE.—On account of shifting conditions the low-water discharge was computed from several rating tables, each covering a short period. The high-water discharge was computed from one current-meter and two slope measurements.

Estimated monthly discharge of Salt Fork of Red River at Mangum, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 11-30	4,900	0	382	15,150
May	8,600	0	439	26,990
June	725	0	165	9,818
July	555	0	97.6	6,001
August	1,240	0	138	8,485
September	180	0	20.5	1,220
October	0	0	0	0
November	1,250	0	149	8,866
December	260	20	85.5	5,257
The period				81,790

TURKEY CREEK NEAR OLUSTEE, OKLA.

This station was established April 20, 1905. It is located about 200 feet downstream from William Fullerton's irrigation dam, 6 miles northwest of Olustee, Okla.

The channel is straight for 200 feet above and below the station. The current is swift. Both banks are high and wooded, but subject to overflow during floods. The bed of the stream is sandy.

Low-water measurements are made by wading at the gage. High-water measurements are made from the highway bridge 1 mile east of the gage.

A staff gage in three sections is fastened to the right bank and trees on the same. An auxiliary gage is located 245 feet below the regular gage, for determinations of slope. During 1905 the gage was read once each day by James R. Craig. Bench marks were established as follows: (1) A group of three nails driven into the root of an elm tree on the right bank, 40 feet above the gage; elevation, 11.65 feet. (2) A point, marked with paint "U. S. R. S. B. M. 16.29," on a rock 20 feet from the gage; elevation 16.29 feet. Elevations refer to the datum of the gage.

Discharge measurements of Turkey Creek near Olustee, Okla., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 20	E. R. Kerby	15	9	1.67	2.40	15
June 5	do	15	10	1.92	2.70	20
July 18	do	11	9	1.29	2.50	11
July 22	do	10	7	1.64	2.47	11
July 22	do	10	7	1.58	2.47	10
July 30	do	16	13.5	.81	2.42	11
July 31	J. M. Giles	16	6	1.12	2.39	7
July 31	E. R. Kerby	16	13.5	.83	2.40	11
August 7	do	11	8	1.50	2.40	12
August 10	do		5.4	1.68	2.40	9
August 11	do	15	11	.75	2.30	8
August 11	do	11	9	1.21	2.30	11
August 18	do		8	1.80	2.50	15
August 21	do	11	10	1.12	2.40	11
August 22	do	11	10	1.15	2.40	12
September 9	do		37	1.89	3.70	70
September 9	do	27	39	1.90	3.70	74
September 20	J. M. Giles	16	9	1.14	2.32	10
September 20	do	16	9	1.14	2.33	10
October 7	do	7	10	2.00	2.50	21
November 2	do		14	1.43	2.50	20
December 9	do		4.4	3.13	2.30	14
December 30	do		4.8	2.90	2.30	14

Daily gage height, in feet, of Turkey Creek near Olustee, Okla., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Dec.
1	.....	2.2	.....	2.5	2.4	.....	2.2	2.3
2	.....	2.2	.....	2.5	2.4	.....	2.2	2.2
3	.....	2.2	.....	2.5	2.5	.....	2.1	2.3
4	.....	2.2	.....	2.5	2.5	.....	2.1	2.3
5	.....	2.2	2.7	2.6	2.4	.....	.....	2.3
6	.....	2.2	2.6	2.6	2.3	.....	.....	2.2
7	.....	2.1	12.2	2.6	2.4	.....	2.5	2.2
8	.....	2.2	10.0	2.6	2.3	.....	2.5	2.3
9	.....	2.2	2.9	2.6	2.3	.....	.....	2.3
10	.....	2.2	2.7	2.5	2.3	3.6	2.4	2.3
11	.....	2.4	2.7	2.5	2.3	4.7	.....	2.3
12	.....	2.5	2.6	2.5	2.3	5.6	.....	2.3
13	.....	6.2	2.7	2.5	2.4	2.7	.....	2.3
14	.....	2.6	2.6	2.5	2.5	2.5	.....	.....
15	.....	2.3	2.6	2.5	2.5	2.4	.....	.....
16	.....	2.3	2.6	2.5	2.5	2.5	.....	.....
17	.....	2.3	2.5	2.5	2.5	2.5	.....	2.3
18	.....	2.2	2.6	2.5	2.5	2.5	.....	2.6
19	.....	2.2	2.6	2.4	2.5	2.4	.....	2.3
20	2.4	7.1	2.6	2.4	2.5	2.5	.....	2.3
21	2.2	9.1	2.5	2.5	2.5	2.4	.....	2.3
22	2.2	13.6	2.5	2.5	2.5	2.3	.....	2.3
23	2.7	2.7	2.6	2.5	2.3	2.2	.....	2.3
24	6.6	2.5	2.5	2.5	2.4	.....	.....	2.2
25	2.6	2.5	2.5	2.6	2.3	2.1	.....	2.3
26	2.6	3.1	2.5	2.5	.....	2.3	.....	2.3
27	2.4	.....	2.5	2.4	.....	2.2	.....	2.2
28	2.3	.....	2.5	2.4	.....	3.5	.....	2.2
29	2.2	.....	2.5	2.4	.....	3.4	.....	2.2
30	2.2	.....	2.5	2.4	.....	2.2	.....	2.2
31	.....	.....	.....	2.4	.....	.....	.....	2.4

NOTE.—Gage out May 27 to June 4; creek dry September 24, and October 5-6 and 11-21. No readings October 22 to November 23, November 26-30, and December 14-16.

WASHITA RIVER AT ANADARKO, OKLA.

This station, established October 25, 1902, by W. G. Russell, is located at the highway bridge one-half mile north of the Anadarko railroad depot.

The channel both above and below the station is straight for 200 feet. The right bank is high and the left bank is low. Both banks are liable to overflow. The bed of the stream is sandy and constant.

Discharge measurements are made from the bridge. The initial point for soundings is the right-bank end of the bridge, downstream side.

A standard chain gage is fastened to the hand rail of the bridge; length of chain, 28.17 feet. During 1905 the gage was read once each day by James H. Dunlap. Bench marks were established as follows: (1) A cross cut on the northeast corner of the capstone of the pier on the right bank: elevation, 22.00 feet. (2) A nail in a large cottonwood tree at the south end of the bridge, east of the road; elevation, 24.54 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 139; 99, p 315; 131, p 187.
Discharge: 84, p 139; 99, p 315; 131, p 188.
Discharge, monthly, 131, p 189.
Gage heights: 84, p 140; 99, p 316; 131, p 188.

Discharge measurements of Washita River at Anadarko, Okla.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 28	E. R. Kerby	60	94	1.47	2.8	138
April 2	do	67	171	1.34	3.20	229
April 24	J. M. Giles	66	150	1.47	3.30	220
April 24	do	66	153	1.43	3.30	219
April 25	Murphy and Kerby	70	219	1.85	4.11	405
April 25	do	70	219	1.93	4.20	424
May 22	E. R. Kerby	70	322	2.55	6.35	822
June 5	J. M. Giles	70	360	2.25	6.50	812
June 8	E. R. Kerby	70	279	2.77	6.30	774
June 21	do	70	183	2.20	4.50	402
July 3	do	69	132	1.54	3.70	203
July 10	do	68	157	1.45	3.50	228
July 24	J. M. Giles	70	286	1.70	4.90	486
August 28	E. R. Kerby	67	138	1.63	3.30	225
August 28	do	67	138	1.64	3.30	226
September 6	do		119	1.39	2.90	166
September 25	J. M. Giles		134	1.40	3.10	187
September 26	do		128	1.33	3.00	171
September 26	E. R. Kerby		130	1.44	3.00	187
September 26	do		130	1.43	3.00	186
October 1	do		94	1.43	2.60	134
October 16	do		93	1.08	2.50	100
October 24	do		92	1.16	2.50	107
November 4	do		92	1.13	2.50	104
November 17	do		137	1.28	2.80	175
November 25	do		129	1.26	2.70	163
November 30	do		222	1.66	3.80	368
November 30	do		219	1.60	3.70	350
December 4	do		185	1.44	3.20	267
December 6	do		154	1.35	3.05	208
December 18	do		142	1.20	2.90	171
December 20	do		139	1.24	2.85	173

Daily gage height, in feet, of Washita River at Anadarko, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.55	2.7	3.3	.....	4.3	18.7	3.9	3.1	3.0	2.6	2.5	3.6
2	2.55	2.7	3.1	3.2	4.2	14.8	3.8	4.3	2.9	2.6	2.5	3.4
3	2.55	2.8	3.1	3.3	4.0	12.7	3.7	3.6	2.8	2.6	2.5	3.3
4	2.55	2.8	3.0	5.3	3.9	9.4	3.7	3.2	2.8	2.6	2.5	3.2
5	2.55	2.8	3.0	4.4	3.8	6.6	3.5	3.1	2.7	2.6	2.7	3.1
6	2.55	2.8	3.1	4.1	3.6	6.0	3.5	3.1	2.8	2.6	3.7	3.0
7	2.55	2.8	3.3	3.8	3.5	5.8	3.4	3.0	3.0	2.6	3.9	3.0
8	2.55	2.9	3.5	3.8	3.4	5.9	3.4	2.9	3.2	2.5	3.5	3.0
9	2.55	2.9	3.8	3.7	3.3	6.8	3.5	2.8	4.7	2.5	3.4	2.9
10	2.5	2.9	4.3	3.7	3.4	7.4	3.5	2.8	7.7	2.5	3.2	2.8
11	2.5	2.9	3.8	7.3	3.6	9.6	3.4	2.7	8.4	2.4	3.0	2.8
12	2.5	2.9	3.5	8.2	3.8	7.2	3.7	2.7	8.6	2.4	3.2	2.8
13	2.5	2.9	3.3	6.3	5.2	5.8	3.4	2.9	5.9	2.5	3.5	2.9
14	2.5	2.9	3.1	4.5	8.2	5.5	3.4	3.1	7.1	2.4	3.2	2.9
15	2.5	2.8	3.1	3.7	10.1	5.1	3.4	4.2	4.8	2.5	2.9	2.9
16	2.5	2.8	3.0	3.7	7.7	5.2	3.3	9.1	4.2	2.6	2.9	2.9
17	2.65	2.8	3.5	3.7	6.2	5.3	3.2	9.4	3.9	2.5	2.9	2.9
18	2.65	2.8	4.0	3.7	5.7	5.0	3.3	9.6	3.7	2.5	2.7	2.9
19	2.65	2.9	4.3	3.4	4.3	4.8	3.4	6.4	3.6	2.4	2.7	2.8
20	2.65	2.9	4.7	3.4	4.0	4.7	3.6	6.4	3.3	2.4	2.7	2.8
21	2.65	3.0	5.1	3.3	5.8	4.5	3.3	6.4	3.2	2.5	2.6	2.8
22	2.6	3.2	6.0	3.2	6.5	4.3	3.4	4.6	3.2	2.5	2.6	2.8
23	2.6	3.5	5.0	3.2	6.4	4.3	5.2	4.1	3.4	2.5	2.6	2.8
24	2.6	3.7	3.9	3.2	6.2	4.2	5.2	3.9	3.3	2.5	2.6	2.8
25	2.6	4.0	3.6	4.1	5.4	4.1	4.5	3.7	3.2	2.5	2.6	2.8
26	2.6	4.2	3.5	6.0	5.2	4.0	4.3	3.5	3.0	2.5	2.6	2.8
27	2.6	3.7	3.5	10.8	12.6	4.0	4.1	3.4	2.9	3.5	2.6	2.8
28	2.6	3.5	3.6	11.0	14.9	4.1	3.6	3.3	2.8	2.5	6.6	2.8
29	2.7	.....	4.6	6.2	17.0	3.9	3.4	3.2	2.7	2.5	5.0	2.8
30	2.7	.....	.....	5.1	18.3	3.8	3.3	3.2	2.7	2.5	4.2	2.8
31	2.7	.....	.....	.....	18.8	.....	3.2	3.1	.....	2.5	.....	2.8

NOTE.—Ice conditions January 10-16 and February 3-14; gage heights to top of ice. Gage heights estimated June 3-4 and December 31.

Daily discharge, in second-feet, of Washita River near Anadarko, Okla., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	105	144	240	.....	455	.....	254	178	177	134	105	333
2	105	144	207	229	435	.....	227	382	162	134	105	300
3	105	.....	207	240	400	.....	203	262	148	134	104	282
4	105	.....	191	600	380	.....	218	194	148	134	104	267
5	105	.....	191	430	363	832	184	178	135	134	136	230
6	105	.....	207	378	327	715	198	183	150	134	300	199
7	105	.....	240	325	310	676	180	167	182	134	342	199
8	105	.....	273	325	290	696	197	152	213	105	273	199
9	105	.....	325	295	274	870	211	137	474	105	256	175
10	.....	.....	413	295	286	990	228	137	.....	105	224	158
11	.....	.....	325	990	320	.....	213	120	.....	90	196	158
12	.....	.....	273	.....	354	950	262	120	.....	90	230	158
13	.....	.....	240	775	513	677	213	152	693	100	285	175
14	.....	.....	207	440	.....	620	213	183	925	85	234	175
15	.....	160	207	295	.....	544	213	369	481	100	190	175
16	.....	160	191	295	.....	563	203	.....	373	115	190	171
17	136	160	273	284	795	581	186	.....	323	100	190	171
18	136	160	360	284	698	525	203	.....	288	100	157	171
19	136	175	413	234	436	489	220	790	272	85	157	162
20	136	175	486	234	382	470	252	790	222	85	157	162
21	136	191	560	220	718	432	203	790	206	107	142	162
22	130	224	730	202	853	390	224	450	206	107	142	162
23	130	273	542	202	835	383	544	357	237	107	142	162
24	130	308	342	202	795	360	544	324	222	107	138	162
25	130	360	290	405	641	334	412	289	206	107	138	162
26	130	395	273	780	603	310	377	258	181	107	141	162
27	130	308	273	.....	.....	300	341	242	175	106	148	162
28	130	273	290	.....	.....	310	255	226	160	106	880	162
29	144	.....	470	820	.....	268	227	208	144	106	580	162
30	144	.....	.....	603	.....	250	210	208	144	105	436	162
31	144	.....	.....	.....	.....	.....	196	194	.....	105	.....	162

NOTE.—The daily discharge was obtained by indirect method. No estimates for ice conditions. No estimate was made for gage heights above 7.5 feet owing to lack of measurements.

Estimated monthly discharge of Washita River at Anadarko, Okla., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum	Minimum.	Mean.	
January 1-9, 17-31	144	105	124	5,946
February 1-2, 15-28	395	144	226	7,172
March 1-29	730	191	319	18,[illegible]
April (26 days)	(a)	202	399	20,[illegible]
May (23 days)	(a)	274	503	22,[illegible]
June (25 days)	(a)	250	541	26,[illegible]
July	544	180	252	15,[illegible]
August (28 days)	(a)	120	287	15,[illegible]
September (27 days)	(a)	135	268	14,[illegible]
October	134	85	109	6,[illegible]
November	880	104	227	13,[illegible]
December	333	158	187	11,[illegible]
The period				179,[illegible]

a Discharge beyond limits of rating table.

OUACHITA RIVER NEAR MALVERN, ARK.

This station was established March 3, 1903, at the Rockport Bridge, 1¾ miles northwest of Malvern, Ark., and was discontinued April 30, 1905. The gage was read by A. M. Baker.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 313-314; 131, p 190.
Discharge: 99, p 314; 131, p 190.
Discharge, monthly: 131, p 193.
Gage heights: 99, pp 314-315; 131, p 191.
Rating table: 131, p 192.

Daily gage height, in feet, of Ouachita River near Malvern, Ark., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	0.4	3.0	3.8	6.4	17	5.0	3.7	3.9	6.7
2	.3	3.9	3.7	5.4	18	3.5	3.5	4.0	5.6
3	1.3	3.2	3.2	6.1	19	3.8	4.0	4.0	5.4
4	1.3	2.8	3.0	12.0	20	3.8	3.7	4.0	6.5
5	1.2	2.6	2.9	7.9	21	3.6	3.7	3.9	7.7
6	1.2	2.4	2.7	6.1	22	3.2	4.2	3.7	7.4
7	1.2	2.4	2.7	5.2	23	3.0	5.0	3.5	6.0
8	1.0	3.0	4.6	4.7	24	2.9	5.6	3.5	5.3
9	1.3	3.7	12.5	4.2	25	2.7	5.7	3.1	7.5
10	2.0	4.5	15.8	3.8	26	2.5	5.4	3.0	8.3
11	1.9	4.9	11.2	7.5	27	2.1	4.9	3.0	7.1
12	11.2	5.8	8.1	7.9	28	2.0	4.2	2.9	6.0
13	10.9	6.0	6.5	6.3	29	2.4	.....	4.5	5.4
14	7.5	5.0	5.5	6.7	30	2.5	.....	8.4	4.6
15	5.2	4.7	4.8	8.6	31	2.7	.....	8.9	.....
16	5.1	4.0	4.2	8.5					

OUACHITA RIVER AT ARKADELPHIA, ARK.

This station was established August 1, 1905, by T. U. Taylor. It is located at the bridge of the St. Louis, Iron Mountain and Southern Railway at Arkadelphia, Ark.

The channel is straight for 500 feet above and 1,200 feet below the station. The current is sluggish at low water. During floods the water spreads out over both banks, but the railroad embankment on the west side forces it through the main channel unless the flood is high enough to flow over the railroad tracks near the passenger depot, one-fourth mile west of the bridge. On the east bank the flood water flows under 73 trestle bents of 12 feet clear space each. The highest water on record occurred in 1882, gage height 27.00 feet.

Discharge measurements are made from the three-span railway bridge. The initial points for soundings are the east faces of the east abutment and each pier, each span being treated as a separate channel.

A standard chain gage is located on the upstream side of the bridge near the middle of the first span from the right bank. During 1905 the gage was read once each day by J. W. Wilson. Bench marks were established as follows: (1) The top of the tie at the gage box; elevation, 35.27 feet. (2) The bridge seat on the north side of the west abutment; elevation, 31.22 feet. (3) A spike in the easternmost of three gum trees about one-eighth mile from the bridge directly across the track from the pumping station of the city waterworks; elevation, 27.00 feet. (4) United States Geological Survey bench mark in the northwest corner of the court-house, marked "246.00;" elevation, 124.57 feet. Elevations refer to the datum of the gage. Bench mark No. 4 is 246.00 feet above sea level.

Daily gage height, in feet, of Ouachita River at Arkadelphia, Ark., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.7	2.9	2.9	4.6	7.1	17	2.8	3.4	2.9	5.5	5.2
2	3.8	2.9	2.9	4.3	3.4	18	1.9	3.2	2.9	5.2	5.0
3	2.8	3.0	3.0	4.1	15.1	19	1.8	3.2	3.1	4.9	5.1
4	2.6	2.8	3.6	4.0	10.3	20	2.2	3.2	4.7	4.7	7.4
5	2.3	2.8	3.9	5.1	8.3	21	2.2	3.4	4.7	4.5	10.3
6	2.2	2.7	4.0	9.2	7.2	22	2.1	3.7	4.5	4.3	10.5
7	2.0	2.7	3.9	8.3	6.6	23	1.8	4.0	4.2	4.2	12.7
8	1.9	2.9	3.7	7.2	6.1	24	1.5	3.3	4.2	4.4	10.4
9	1.7	3.5	3.5	6.6	5.7	25	1.4	3.2	6.3	4.3	8.6
10	1.6	3.5	3.4	11.0	5.4	26	1.4	3.1	9.5	4.6	7.5
11	1.5	3.3	3.3	11.7	5.1	27	2.4	3.0	8.7	4.9	6.8
12	1.4	4.1	3.1	8.1	5.0	28	3.1	3.0	6.9	4.8	8.0
13	1.3	4.6	3.0	8.2	4.9	29	3.0	3.0	5.8	10.7	7.7
14	1.6	4.3	3.0	7.0	5.2	30	3.0	3.0	5.2	9.5	7.6
15	2.3	3.8	2.9	6.8	5.4	31	2.9	.....	4.9	.....	7.2
16	2.0	3.6	2.9	6.8	5.3						

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 173.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Braly Building; San Francisco, Cal., 432 Merchants' Exchange Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Great Falls, Mont.; Hazen, Nev.; Boise, Idaho; Spokane, Wash., 424 Peyton Block; Pendleton, Oreg.

Correspondence should be addressed to

THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

JULY, 1906.

O

Water-Supply and Irrigation Paper No. 174 Series P, Hydrographic Progress Reports, 50

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART X.—Western Gulf of Mexico and Rio Grande Drainages

BY
T. U. TAYLOR and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART X.

By T. U. Taylor and John C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain

information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the Division of Hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The Report of Progress of Stream Measurements, which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay, and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico, and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have, in most cases, been redivided, and the facts have been arranged, as far as practicable, geographically.

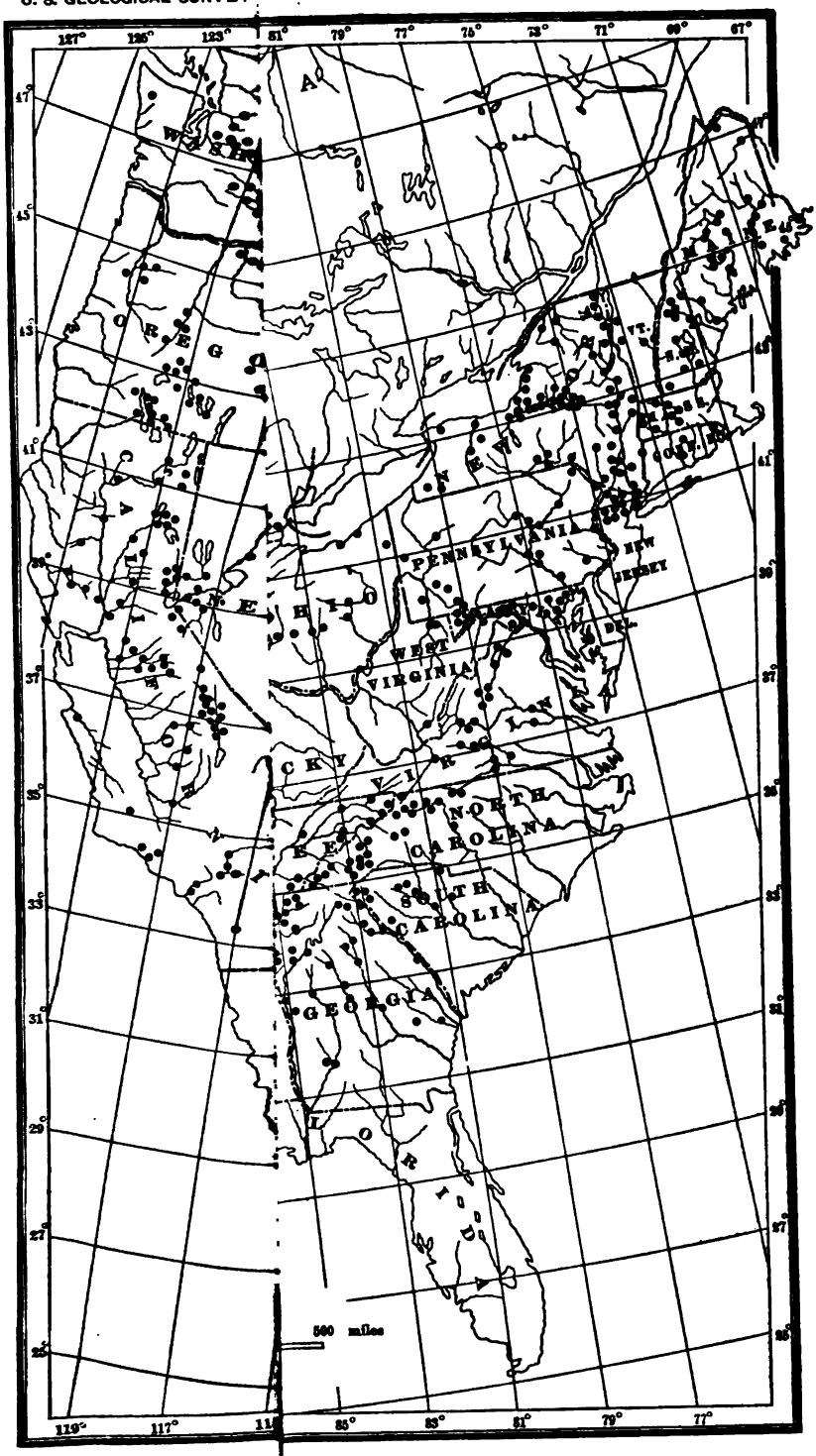
List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. Johns.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor southern Atlantic.


127°
125°
123°
81°
79°
77°
75°
73°
71°
69°
67°
47°
45°
43°
41°
39°
37°
35°
33°
31°
29°
27°
25°
PENNSYLVANIA
NEW JERSEY
WEST VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
500 miles
119°
117°
85°
83°
81°
79°
77°

DURING 1905.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadalupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—"the run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest; this is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example. 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers one square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year eqnals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eights mile, nearly.
1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.

1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1¼ horsepowers equal about 1 kilowatt.
To calculate waterpower quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025l\sqrt{h^3}$; l = length of weir in inches; h = head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:

Scale 1:125000, 1 mile = 0.50688 inch.
Scale 1:90000, 1 mile = 0.70400 inch.
Scale 1:62500, 1 mile = 1.01376 inches.
Scale 1:45000, 1 mile = 1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow, special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general, the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are, in general, only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flashboards or exceptional care in reducing leaking through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

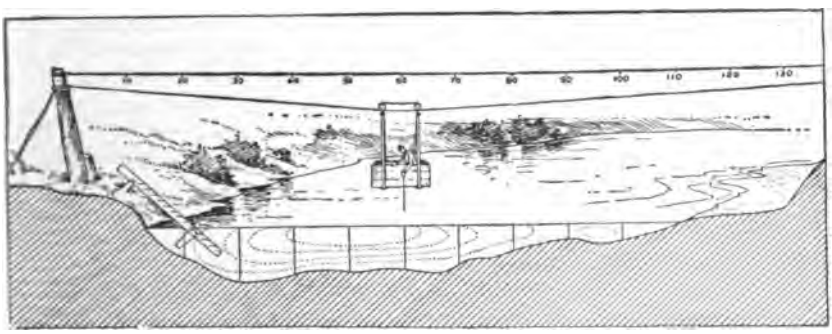


FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads, and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope, due to the rise and fall of the stream, be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity-curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the

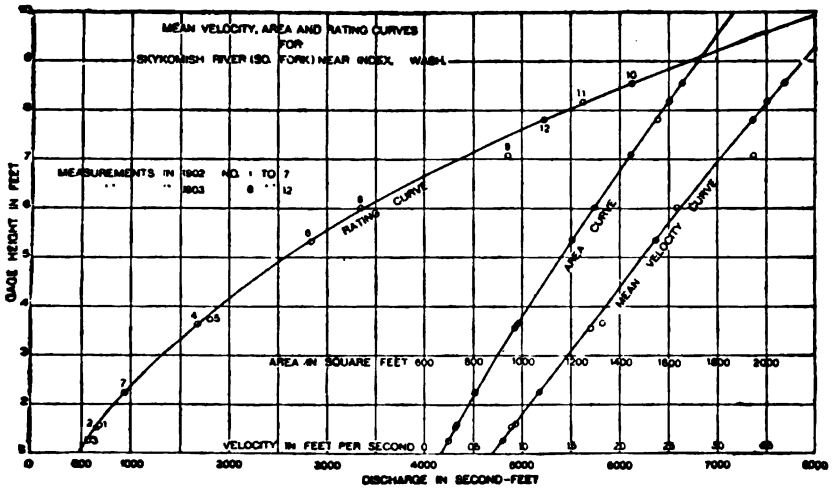


Fig. 2.—Discharge, mean-velocity, and area curves for South Fork of Skykomish River near Index, Wash.

form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists

on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in Engineering News of April 21, 1904. This method or a graphical application of it is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted these hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Colorado.—District and resident hydrographer, M. C. Hinderlider,[a] assisted by R. I. Meeker, Wm. A. Lamb, A. A. Weiland, Melvin Beeson, Thomas E. Brick, and F. L. Meeker. Acknowledgments are due the Colorado and Southern, Burlington and Missouri River, Union Pacific, and Chicago, Burlington and Quincy railroads for free transportation for hydrographers over their lines, also to the Denver Union Water Company for the free use of their reservoir for a rating station.

Louisiana.—District hydrographer, Thomas U. Taylor.[b]

New Mexico.[c]—The hydrographic work in the northern portion of this territory was carried on under the direction of M. C. Hinderlider, district hydrographer, assisted as follows: The work in the north central portion was in charge of R. I. Meeker, while the work in the northwestern portion was in charge of O. H. Timmerman. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on Mora River acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of La Cueva, N. Mex., also to James D. Hand, of Los Alamos, N. Mex., for similar favors. Transportation in the form of annual passes was furnished Mr. Meeker by the Denver and Rio Grande and Atchison, Topeka and Santa Fe railroads. The work in the southern and eastern portion was under the direction of J. M. Giles, assisted by Earl Patterson. Acknowledgments are due the St. Louis and San Francisco, the Chicago, Rock Island and Pacific, the Southern Kansas, the Fort Worth and Denver City, and the Texas and Pacific railroads for transportation furnished Mr. Giles, and the Pecos Valley lines for transportation furnished Mr. Patterson.

Texas.—District hydrographer, Thomas U. Taylor, assisted by H. H. Fox, E. C. H. Bantel, and B. M. Haberer. Acknowledgments are due the Missouri, Kansas and Texas, the International and Great Northern, the Houston and Texas Central, the Southern Pacific, the Texas and Pacific, the Fort Worth and Denver City, the Gulf, Colorado and Santa Fe, the St. Louis Southwestern (Cotton Belt), and the San Antonio and Aransas Pass railroads for transportation for the district hydrographers. Also to the Army engineers for gage heights at Riverside and for maps of Brazos River from the Gulf to Waco.

Special acknowledgment is due for the results of the data collected at certain stations in the Rio Grande drainage basin, to members of the International (Water) Boundary Commission as follows: Gen. Anson Mills, commissioner on the part of the United States; Señor Don Jacobo Blanco, commissioner on the part of Mexico, and W. W. Follett, consulting engineer on the part of the United States.

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[a] Office of district hydrographer for Colorado, Kansas, Nebraska, northern New Mexico, and Wyoming, Chamber of Commerce Building, Denver, Colo.

[b] Office of the district hydrographer for Texas, Arkansas, and Louisiana, Austin, Tex.

[c] District hydrographer for southern and eastern New Mexico, southern Oklahoma, and southern Indian Territory, J. M. Giles, Carlsbad, N. Mex.

SABINE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Sabine River has its headwaters in Collin and Hunt counties, Tex., flows in a southeasterly direction to the State line, then south, forming the boundary between Texas and Louisiana, and empties into Sabine Lake, an arm of the Gulf, near Orange, Tex. The small tributaries in eastern Texas support many small water mills, and the Sabine itself is navigable for several hundred miles. The drainage area of the Sabine in Texas above Orange is 7,500 square miles and its total drainage area above Orange in Louisiana and Texas is 10,400 square miles.

SABINE RIVER NEAR LONGVIEW, TEX.

This station was established January 1, 1904, by Thomas U. Taylor. It is located at the bridge of the International and Great Northern Railroad, about 3 miles southwest of Longview Junction, Tex.

The channel is straight for 150 feet above and 400 feet below the station. The current is sluggish. The right bank is low and cleared along the right of way of the railroad. The left bank is high and composed in its lower half of sandstone; it is cleared above and wooded below the station. The bed of the stream is rocky and fairly permanent. Old piles left from the false work used in erecting the bridge give trouble in making measurements at low water.

Discharge measurements are made from the bridge. The initial point for soundings is the east face of the west abutment.

A standard chain gage is attached to the guard rail of the bridge. During 1905 the gage was read twice each day by John Wadsack. Bench marks were established as follows: (1) The top of abutment, northeast corner, marked "U. S. G. S. 42.08 B. M."; elevation, 42.08 feet. (2) The top of an iron rod buried in a vertical position in the yard of the bridge watchman, 6 feet from the southeast corner of his house, 3 feet from the second post east of the gate, and 8 inches from the wire fence; elevation, 47.00 feet. (3) The top of tie at the gage; elevation, 45.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 322; 132, pp 19-20.
Discharge: 99, p 322; 132, p 20.
Discharge, monthly: 132, p 23.
Gage heights: 132, p 21.
Rating table: 132, p 22.

Discharge measurements of Sabine River near Longview, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
July 9	T. U. Taylor	3,660	3.08	30.1	11,270
July 10	do	4,150	3.67	32.6	15,240
July 11	do	4,316	3.85	33.4	16,630

Daily gage height, in feet, of Sabine River near Longview, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.0	7.65	16.15	17.65	28.9	32.4	24.9	25.95	7.1	7.4	12.3	9.8
2	7.5	7.65	15.3	18.5	30.2	31.7	23.35	26.15	7.1	7.4	11.2	10.8
3	7.25	7.7	13.75	23.85	31.85	31.15	21.75	26.4	7.1	7.3	10.3	10.8
4	7.15	7.8	11.65	24.7	32.6	30.55	22.15	26.5	7.0	7.3	9.4	10.7
5	7.1	7.8	10.1	24.35	32.55	29.55	24.15	26.35	6.95	7.3	9.0	11.5
6	7.0	7.8	9.4	23.35	32.2	28.5	25.2	25.65	6.9	7.2	9.3	12.6
7	7.0	8.25	9.05	22.55	32.15	26.75	26.6	23.65	6.9	7.2	9.5	13.0
8	6.9	10.05	9.35	21.05	32.55	24.1	28.1	19.45	6.9	7.1	9.8	13.3
9	6.95	11.75	10.8	21.65	33.0	20.6	29.95	15.0	7.0	7.0	10.2	13.3
10	7.0	12.55	13.95	21.65	33.9	15.85	32.8	11.4	7.0	6.9	10.9	12.9
11	7.45	12.55	14.4	22.1	34.05	11.6	33.4	10.3	6.9	6.9	11.7	12.0
12	9.3	12.1	14.2	22.95	34.3	9.8	33.15	9.9	6.8	6.8	12.9	11.0
13	11.4	11.4	15.15	23.95	33.25	9.6	32.7	9.25	6.8	6.8	14.2	12.5
14	11.15	10.8	15.6	24.6	34.1	9.45	32.2	8.95	6.9	6.8	15.3	15.0
15	10.8	10.6	16.2	24.85	33.45	9.3	31.7	8.55	6.9	6.8	16.4	16.4
16	10.25	10.75	17.15	24.7	33.1	9.4	31.25	8.35	6.9	6.7	17.1	17.8
17	9.4	11.05	17.4	23.45	33.6	9.25	31.1	8.15	6.9	6.9	17.7	19.4
18	9.0	11.3	20.45	21.65	34.9	9.05	31.1	7.95	6.8	7.1	18.2	21.3
19	8.85	13.95	27.8	21.95	35.05	9.7	31.15	7.8	6.9	7.2	18.7	25.6
20	9.35	17.15	27.45	23.2	34.9	10.5	30.7	7.7	7.05	7.9	18.9	28.2
21	9.3	17.75	27.15	24.15	34.45	10.2	30.25	7.55	7.55	9.1	18.6	29.4
22	8.95	17.05	27.05	24.15	34.05	11.15	29.65	7.4	8.05	10.6	17.0	29.4
23	8.45	16.35	26.25	23.85	33.55	16.0	29.4	7.4	7.95	11.9	14.0	30.0
24	8.05	16.0	25.0	24.0	33.4	13.85	28.35	7.3	7.7	12.1	11.1	33.6
25	7.8	16.9	23.45	27.15	33.6	13.7	27.15	7.25	7.95	11.7	9.7	33.8
26	7.7	16.05	21.6	27.65	34.25	15.05	26.1	7.25	7.95	10.2	9.3	33.6
27	7.55	16.35	19.4	27.5	34.7	21.6	25.5	7.1	7.8	9,5	9.1	33.2
28	7.5	16.45	16.1	27.5	34.65	27.15	25.05	7.1	7.7	10.1	9.0	32.8
29	7.4	.....	17.2	27.6	34.25	26.95	25.0	7.05	7.6	11.9	8.9	32.1
30	7.7	.....	18.65	28.15	33.65	26.15	25.25	7.0	7.45	13.2	8.9	31.8
31	7.65	.....	18.55	.....	33.05	.....	25.55	7.0	.....	13.4	.....	30.4

Station rating table for Sabine River near Longview, Tex., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	44	7.90	300	9.80	660	13.40	1,461
6.10	53	8.00	317	9.90	680	13.60	1,509
6.20	63	8.10	335	10.00	700	13.80	1,557
6.30	74	8.20	353	10.20	742	14.00	1,605
6.40	85	8.30	371	10.40	784	14.20	1,653
6.50	97	8.40	389	10.60	826	14.40	1,701
6.60	109	8.50	407	10.80	869	14.60	1,750
6.70	122	8.60	426	11.00	913	14.80	1,800
6.80	135	8.70	445	11.20	957	15.00	1,850
6.90	148	8.80	464	11.40	1,001	15.50	1,975
7.00	162	8.90	483	11.60	1,045	16.00	2,103
7.10	176	9.00	502	11.80	1,090	16.50	2,233
7.20	190	9.10	521	12.00	1,136	17.00	2,366
7.30	205	9.20	540	12.20	1,182	18.00	2,640
7.40	220	9.30	560	12.40	1,228	19.00	2,938
7.50	235	9.40	580	12.60	1,274	20.00	3,310
7.60	251	9.50	600	12.80	1,320	21.00	3,746
7.70	267	9.60	620	13.00	1,366	22.00	4,230
7.80	283	9.70	640	13.20	1,413		

The above table is based on 23 discharge measurements made during 1904 and 3 made during 1905. It is well defined between gage heights 6 feet and 22 feet. Above 22 feet the discharge is only approximate. Below 19 feet the table is the same as for 1904.

Estimated monthly discharge of Sabine River near Longview, Tex., for 1905.

[Drainage area, 2,900 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,001	148	385	23,670	0.133	0.153
February	2,570	259	1,251	69,480	.431	.449
March	8,490	512	3,134	192,700	1.08	1.24
April	8,865	2,542	5,511	327,900	1.90	2.12
May	19,480	9,735	16,640	1,023,000	5.74	6.62
June	14,980	512	4,470	266,000	1.54	1.72
July	16,680	4,106	9,777	601,200	3.37	3.88
August	7,316	162	1,934	118,900	.667	.769
September	326	135	195	11,600	.067	.075
October	1,461	122	461	28,350	.159	.183
November	2,907	483	1,332	81,900	.459	.512
December	17,360	660	6,388	392,800	2.20	2.54
The year	19,480	122	4,290	3,138,000	1.48	20.26

NECHES RIVER AT EVADALE, TEX.

A gaging station was established on Neches River at Evadale July 1, 1904, by Thomas U. Taylor. It is located at the bridge of the Gulf, Beaumont and Kansas City Railway.

The clear span or water way under each arm of the draw span is 50 feet, and the bridge continues each way on trestles. The left bank is high, whence the name of the railroad station, Fords Bluff, but the right or west bank is low and the trestle work continues about half a mile from the river channel.

Discharge measurements are made from the bridge at ordinary and high stages. At low water the current is very sluggish, and discharge measurements are made at shoals above or below the station.

Gage readings are made by reading down from the top of the tie to the water surface by means of a tape. The zero of the gage is 40.00 feet below the top of the tie in the west arm of the draw span of the bridge. During 1905 the gage was read by W. H. Whittemore.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 132 of the United States Geological Survey, pages 23–24.

Discharge measurements of Neches River at Evadale, Tex., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
March 27	H. H. Fox	21.6	13,730
March 29	do	22.1	14,240
June 24	T. U. Taylor	15.2	3,389
July 3	do	18.1	7,130

Daily gage height, in feet, of Neches River at Evadale, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	19.2	16.6	19.4	21.5	21.0	22.1	20.0	18.7	11.1	7.9	8.6	14.7
2	19.2	16.6	19.3	21.3	21.1	21.9	18.4	18.2	10.8	7.9	8.6	14.1
3	19.0	17.2	19.2	21.1	21.3	21.7	17.8	17.6	10.3	7.8	8.7	13.3
4	18.5	17.0	19.1	21.1	21.5	21.7	17.5	17.1	10.0	7.8	8.8	13.6
5	18.0	16.5	19.0	21.4	21.8	21.6	17.2	16.9	10.0	7.8	9.2	14.1
6	17.8	16.0	18.8	21.6	21.8	21.5	17.3	16.8	9.6	7.8	9.6	14.1
7	17.8	16.0	18.7	21.8	21.8	21.3	17.5	17.1	10.3	7.8	10.0	14.1
8	17.9	16.6	18.5	22.0	21.8	21.1	17.9	18.6	11.8	7.8	11.4	14.2
9	17.9	17.0	18.3	22.3	21.7	20.6	18.7	19.0	11.3	7.8	12.8	14.3
10	17.9	17.3	18.2	22.5	21.7	20.0	19.4	19.3	10.6	7.7	13.9	14.0
11	17.8	17.7	19.6	22.6	21.7	19.2	19.7	19.2	10.0	7.7	15.1	14.0
12	17.7	18.0	19.1	22.6	21.8	18.1	20.0	19.2	9.4	7.6	16.0	14.1
13	17.5	18.5	19.4	22.5	21.9	17.2	20.3	19.2	9.1	7.6	16.9	14.5
14	17.3	19.0	19.7	22.3	22.0	16.8	20.7	19.1	9.0	7.5	17.2	14.8
15	17.5	19.6	19.9	22.0	22.0	16.1	20.9	18.9	9.0	7.4	18.0	15.2
16	17.2	19.3	19.7	21.7	22.1	15.7	21.1	18.5	9.1	7.5	18.0	16.0
17	17.5	19.3	19.6	21.5	22.2	15.4	21.4	17.8	8.7	7.5	17.9	16.8
18	16.7	19.0	19.6	21.3	22.3	15.2	21.6	17.0	8.5	7.4	17.9	17.0
19	15.9	18.6	19.9	21.1	22.6	14.9	21.7	16.1	8.5	7.4	17.7	17.1
20	15.0	18.4	20.2	21.0	22.9	14.5	21.9	15.4	8.5	7.4	17.5	17.2
21	14.7	18.4	20.5	20.9	23.1	14.0	21.8	14.7	8.5	7.2	17.6	17.2
22	14.6	19.0	20.8	20.6	23.4	13.4	21.6	14.1	8.4	7.2	17.6	18.1
23	14.3	19.4	21.0	20.4	23.6	13.7	21.4	13.6	8.4	7.2	17.7	18.4
24	14.1	19.6	21.1	20.5	23.6	14.6	21.2	13.1	8.4	7.0	17.5	18.6
25	14.0	19.5	21.5	20.4	23.5	17.9	21.1	12.5	8.4	7.0	17.4	19.1
26	13.7	19.7	21.5	20.3	23.3	18.5	20.7	11.9	8.3	7.3	17.1	19.7
27	13.6	19.7	21.6	20.3	23.1	18.7	20.4	11.4	8.2	7.6	16.7	19.9
28	13.6	19.6	21.7	20.3	23.0	19.1	20.1	11.0	8.1	7.9	16.1	20.1
29	13.4	.....	21.8	20.4	22.7	19.3	19.9	10.6	8.0	8.0	15.7	19.8
30	13.1	.....	21.8	20.8	22.5	19.1	19.2	10.8	7.9	8.3	15.2	19.8
31	15.0	.....	21.6	.....	22.4	.....	19.5	11.4	.....	8.6	.....	20.0

Station rating table for Neches River at Evadale, Tex., from July 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.00	180	6.70	429	8.80	854	12.00	1,800
5.10	191	6.80	447	9.00	900	12.50	2,010
5.20	202	6.90	465	9.20	948	13.00	2,248
5.30	214	7.00	484	9.40	997	13.50	2,508
5.40	226	7.10	503	9.60	1,047	14.00	2,790
5.50	239	7.20	522	9.80	1,098	14.50	3,110
5.60	252	7.30	541	10.00	1,150	15.00	3,480
5.70	266	7.40	560	10.20	1,204	15.50	3,890
5.80	280	7.50	580	10.40	1,260	16.00	4,350
5.90	295	7.60	600	10.60	1,318	17.00	5,410
6.00	310	7.70	620	10.80	1,378	18.00	6,660
6.10	326	7.80	640	11.00	1,442	19.00	8,270
6.20	342	7.90	660	11.20	1,509	20.00	10,100
6.30	359	8.00	680	11.40	1,578	21.00	12,090
6.40	376	8.20	722	11.60	1,650	22.00	14,300
6.50	393	8.40	765	11.80	1,724	23.00	16,750
6.60	411	8.60	809				

The above table is based on seven discharge measurements made during 1904-5. It is fairly well defined between gage heights 5.6 feet and 22 feet. Above 22 feet the discharge is approximate.

Estimated monthly discharge of Neches River at Evadale, Tex., for 1904 and 1905.

[Drainage area, 8,200 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
July	1,232	503	1,027	63,150	0.125	0.144
August	1,922	411	879	54,050	.107	.123
September	640	326	463	27,550	.056	.062
October	503	202	291	17,890	.035	.040
November	266	202	209	12,440	.025	.028
December	7,590	280	1,043	64,130	.127	.146
The period				239,200		
1905.						
January	8,620	2,298	5,090	313,000	.621	.716
February	9,580	4,350	7,171	398,300	.875	.911
March	13,840	6,960	10,210	627,800	1.25	1.44
April	15,750	10,670	12,870	765,800	1.57	1.75
May	18,300	12,090	15,070	926,600	1.84	2.12
June	14,540	2,454	7,865	468,000	.959	1.07
July	14,070	5,640	10,180	625,900	1.24	1.43
August	8,800	1,318	5,127	315,200	.625	.721
September	1,724	660	986	58,670	.120	.134
October	809	484	606	37,260	.074	.085
November	6,660	809	4,217	250,900	.514	.574
December	10,290	2,402	5,312	326,600	.648	.747
The year	18,300	484	7,059	5,114,000	.861	11.70

TRINITY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Trinity River rises in a network of small streams in the counties of Montague, Jack, Wise, Denton, and Parker, Tex., but their combined flow above Dallas is not sufficient to keep the bottom or bed of the stream moist in dry times. Below Dallas the Trinity flows through a wooded country, and consequently it is not subject to sudden floods with their quick run-offs.

TRINITY RIVER AT RIVERSIDE, TEX.

A gaging station was established on Trinity River at Riverside, Tex., in December, 1902, by Thomas U. Taylor. It is located at the bridge of the International and Great Northern Railroad.

The channel is straight for 300 feet above and 1,000 feet below the bridge. The current is sluggish at low and swift at high stages. The right bank is high and rocky. The left bank is lower than the right, a trestle being used to measure the overflow at flood stages. The bed of the stream consists of tough mud or clay.

Discharge measurements are made from the railroad bridge. The initial point for soundings is the north face of the south abutment for the south channel. For the north channel the north face of the pier is the initial point.

During 1905 the gage was read by G. W. Higdon. The zero of the gage is 66.00 feet below the top of the ties (or base of rail) in the north arm of the draw span of the International and Great Northern Railroad bridge. The elevation of the top of the pivot pier above gage datum is 56.50 feet, and that of the top of the channel of the lower chord of the arms of the draw span of the bridge is 62.90 feet. According

to the survey of the United States Army engineers the elevation of the top of the tie with reference to mean low tide of the gulf is 148.70 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, pp 142-143; 99, pp 322-323; 132, p 25.
Discharge: 84, p 143; 99, p 323; 132, p 26.
Discharge, monthly: 99, p 325; 132, p 28.
Gage heights: 99, pp 323-324; 132, p 26.
Rating table: 99, p 324; 132, p 27.

Discharge measurements of Trinity River at Riverside, Tex., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 4	T. U. Taylor	37.6	24,690
July 4	do	37.0	23,800
July 5	do	35.8	21,420
July 5	do	34.8	20,490
July 6	H. H. Fox	32.7	18,970
July 7	do	31.5	17,890
July 8	do	30.2	17,320

Daily gage height, in feet, of Trinity River at Riverside, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.4	9.2	17.9	28.5	42.5	49.1	45.7	34.4	10.4	8.5	11.5	11.2
2	9.5	9.5	15.4	25.6	43.1	48.6	44.0	34.4	10.1	8.4	11.2	12.0
3	9.1	9.5	12.7	29.2	42.9	48.0	41.6	34.3	9.3	8.3	10.5	12.2
4	8.9	9.4	11.4	29.2	41.4	47.4	38.5	33.7	9.1	8.3	10.3	11.9
5	8.8	9.4	10.7	29.0	39.4	46.9	35.8	33.7	8.9	8.2	10.2	11.5
6	8.6	9.4	10.2	28.6	37.7	46.4	33.5	32.2	8.9	8.1	10.3	11.1
7	8.5	9.7	10.0	27.5	36.3	46.1	31.8	31.9	8.9	8.1	11.1	12.5
8	8.4	10.7	10.0	26.6	35.8	45.9	30.3	31.4	8.8	8.0	12.3	12.7
9	8.4	13.2	22.8	26.2	36.4	45.9	32.4	30.9	8.7	8.0	12.6	12.4
10	8.4	13.6	15.4	26.2	38.0	45.9	34.3	29.9	8.7	10.0	17.5	11.7
11	8.3	13.3	16.4	26.2	38.6	45.8	35.2	28.5	8.6	13.0	17.6	11.0
12	9.5	14.0	23.3	26.7	39.0	45.6	35.7	26.3	8.5	13.5	17.9	10.5
13	11.7	14.3	20.1	27.2	39.6	45.0	35.5	18.7	8.5	12.9	17.7	10.5
14	11.4	15.0	18.8	27.7	40.6	44.2	34.5	14.0	8.4	11.9	17.3	12.8
15	10.6	15.1	19.4	27.8	43.3	43.6	33.7	11.9	8.4	10.7	17.9	17.2
16	9.9	14.5	20.0	27.8	46.6	41.8	32.7	11.4	8.4	10.0	17.7	18.6
17	10.0	13.6	20.0	27.8	48.5	38.0	31.9	11.2	8.3	9.4	19.4	20.0
18	11.9	12.5	22.6	27.4	49.8	29.7	31.0	11.2	8.3	9.0	19.5	20.5
19	12.7	15.7	27.0	27.2	50.0	19.7	31.0	11.0	8.2	8.9	19.7	22.5
20	12.7	19.7	27.3	26.7	52.4	15.7	29.5	10.5	8.7	9.2	19.6	25.7
21	11.9	19.4	28.1	25.4	48.9	14.0	32.1	10.3	9.0	13.5	19.4	29.8
22	10.9	19.9	29.2	22.1	48.0	16.4	29.0	10.0	9.0	14.1	18.7	31.9
23	10.2	18.9	27.5	18.3	47.1	18.8	29.2	10.0	9.2	13.8	17.1	32.5
24	9.7	18.0	26.7	17.4	46.2	18.8	30.0	10.0	9.2	14.0	15.7	32.3
25	8.7	18.0	27.2	32.9	46.5	18.1	30.1	9.7	9.7	14.7	15.7	31.8
26	9.1	18.5	26.4	36.4	46.6	18.8	30.5	9.7	9.8	14.2	14.7	31.5
27	9.0	18.8	28.2	37.7	47.7	37.7	30.5	9.5	9.5	13.2	14.1	31.5
28	8.9	18.6	29.0	36.3	48.9	44.8	31.0	8.4	9.3	12.2	13.6	32.0
29	8.8	.....	32.1	34.2	47.7	47.0	33.8	8.3	9.0	12.4	12.6	32.3
30	8.8	.....	31.1	40.6	49.9	46.8	34.1	8.3	8.7	12.2	11.8	32.7
31	8.8	.....	30.3	.....	48.7	.....	34.1	10.6	.....	12.5	.....	33.6

Estimated monthly discharge of Trinity River at Riverside, Tex., for 1905.

[Drainage area, 16,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	2,779	441	1,108	68,130	0.069	0.080
February	8,081	761	4,064	225,700	.254	.264
March	18,580	1,150	9,716	597,400	.607	.700
April	26,730	6,138	15,310	911,000	.957	1.07
May	38,500	22,020	30,260	1,861,000	1.89	2.18
June	35,200	3,630	24,180	1,439,000	1.51	1.68
July	31,800	15,780	20,070	1,234,000	1.25	1.44
August	20,680	441	8,136	500,300	.508	.586
September	1,375	413	682	40,580	.043	.048
October	4,127	360	1,848	113,600	.116	.134
November	7,923	1,261	4,613	274,500	.288	.321
December	19,950	1,433	9,270	570,000	.579	.668
The year	38,500	360	10,770	7,835,000	.673	9.17

NOTE.—Above estimates subject to large error for low and medium stages owing to the inconsistent data on which the rating table was based.

BRAZOS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

This river has its source in the Staked Plains region of western Texas and has a general southeasterly course, emptying into the Gulf of Mexico south of the mouth of Trinity River. Its drainage basin is entirely within the State of Texas.

BRAZOS RIVER AT WACO, TEX.

This station was established September 14, 1898, by Thomas U. Taylor. It is located at the suspension bridge on Bridge street, Waco, Tex.

The channel is straight for 1,000 feet above and 300 feet below the station. There is a good current at all stages. The right bank is composed of limestone and does not overflow. The left bank is high, but overflows during floods. The bed of the stream is composed of sand, free from vegetation, and slightly shifting. A single-span truss bridge crosses the river at an angle of 76° about 300 feet above the suspension bridge.

Discharge measurements are made from the suspension bridge. The initial point for soundings is the edge of the right abutment.

An inclined gage in three sections is located on the left bank under the bridge. During 1905 the gage was read twice each day by W. J. Cassaday. Bench marks were established as follows: (1) The top of the water table on the top of the south pier of the abutment of the suspension bridge, about 3 inches above the floor, marked "U. S. G. S. B. M."; elevation, 44.33 feet above the datum of the gage. (2) United States Coast and Geodetic Survey bolt in the side of Patton's feed store; elevation, 55.60 feet above the datum of the gage and 413.18 feet above mean low tide. (3) The floor of the truss bridge above the suspension bridge, at the foot of the downstream batter brace on the Waco side; elevation, 45.40 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 28, p 118; 37, p 272; 50, p 333; 66, p 58-59; 84, pp 143-144; 99, pp 325-326; 132, pp 28-29.
Discharge: 28, p 129; 37, p 272; 50, p 334; 66, p 59; 84, pp 144-145; 99, p 327; 132, p 30.
Discharge, monthly: 75, pp 150-151; 84, p 146; 99, p 328; 132, p 31.
Gage heights: 28, p 121; 37, p 273; 50, p 334; 66, p 59; 84, p 145; 99, p 327; 132, p 30.
Rating tables: 66, p 173; 84, p 146; 99, p 328; 132, p 31.

Discharge measurements of Brazos River at Waco, Tex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 1[a]	W. J. Cassaday	450	11,350	7.75	29.0	88,000
May 2	H. H. Fox	450	4,055	4.02	12.5	16,320
May 2	do	450	3,540	3.78	11.4	13,400
May 2	do	450	4,660	4.22	13.9	19,680
May 3	do	440	2,800	3.40	9.7	9,520
May 3	do	445	3,100	3.51	10.4	10,880
May 4	do	440	2,390	3.26	8.8	7,790
May 8	do	480	10,420	7.11	26.7	74,110
May 9	do	460	6,820	5.59	18.8	38,090
May 9	do	450	5,210	4.44	15.3	23,140
August 10	T. U. Taylor	380	1,140	3.00	6.1	3,418
August 11	do	380	960	2.78	5.5	2,673
August 12	do	380	888	2.62	5.4	2,322
August 19	do	380	524	1.65	3.9	866
August 26	do	305	386	1.53	3.5	591

[a] Float measurement.

Daily gage height, in feet, of Brazos River at Waco, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.8	3.2	4.8	25.0	7.1	7.1	6.9	3.1	3.35	3.05	3.15
2	2.5	2.8	3.2	10.35	12.9	6.9	6.55	6.7	3.1	3.15	3.0	3.2
3	2.5	2.75	3.2	11.6	10.5	6.65	6.3	6.55	3.1	3.0	2.9	3.15
4	2.5	2.7	3.15	8.7	9.3	6.0	6.75	6.4	3.0	4.8	2.85	3.1
5	2.5	2.7	3.1	7.7	9.1	5.75	6.55	6.05	3.1	5.9	2.8	3.0
6	2.5	2.7	3.1	7.35	13.15	5.35	6.7	6.0	3.0	4.9	2.8	2.95
7	2.5	2.7	3.3	7.05	10.7	4.9	9.2	7.1	3.0	4.55	2.8	2.85
8	2.5	2.7	3.75	6.65	14.1	4.8	7.95	7.6	3.0	4.1	2.75	2.8
9	2.5	2.85	4.5	6.55	15.0	4.7	7.3	7.1	3.0	4.25	3.65	2.8
10	2.5	3.5	4.15	6.4	5.2	4.65	6.9	6.55	2.95	4.65	4.15	2.8
11	2.55	3.3	4.0	5.9	9.35	4.55	6.5	5.75	2.9	4.4	3.95	2.8
12	5.3	3.3	3.75	5.65	11.0	4.4	7.7	5.75	3.0	4.6	3.85	2.85
13	4.55	3.2	3.65	5.3	17.45	4.3	7.4	5.5	8.1	4.3	5.0	4.1
14	3.25	3.1	3.55	5.9	28.6	4.25	7.65	5.0	8.95	4.1	4.5	5.1
15	2.9	2.95	3.6	4.55	13.5	4.4	7.4	4.75	7.3	3.95	4.3	4.95
16	2.65	3.5	4.05	4.45	11.8	4.9	6.55	4.6	6.6	3.75	4.3	4.45
17	3.1	3.0	5.65	4.25	11.7	4.75	6.45	4.35	6.3	3.55	4.15	4.2
18	3.2	3.6	8.15	4.1	10.5	4.55	6.1	3.95	6.45	3.4	3.85	4.25
19	3.1	4.85	6.3	4.1	9.3	4.65	5.55	3.75	6.3	5.35	3.65	4.95
20	3.0	4.95	6.1	4.1	8.6	4.8	4.9	5.15	6.05	7.55	3.5	5.45
21	3.0	4.4	7.25	4.05	7.8	7.6	4.45	4.7	6.65	6.6	3.45	5.1
22	2.95	3.75	5.5	4.0	13.8	8.8	4.2	4.35	5.05	5.75	3.35	4.5
23	2.9	3.55	5.1	4.0	12.7	7.35	4.7	4.0	4.5	5.55	3.3	4.15
24	2.9	3.4	4.95	14.2	16.15	8.25	4.5	3.9	4.3	5.1	3.4	4.0
25	2.9	3.25	4.55	14.0	15.05	7.5	4.75	3.8	4.1	4.4	3.4	3.9
26	2.85	3.2	4.15	8.8	13.9	7.55	6.8	3.65	4.0	4.15	3.4	3.7
27	2.8	3.25	4.05	13.15	13.35	8.35	12.0	3.45	3.85	4.0	3.35	3.55
28	2.8	3.3	4.05	9.3	11.6	12.55	17.1	3.3	3.8	3.75	3.25	3.5
29	2.8	.....	5.1	10.1	9.0	8.65	12.9	3.25	3.65	3.55	3.2	3.45
30	2.8	.....	5.15	22.0	8.7	7.45	9.0	3.2	3.55	3.45	3.1	3.4
31	2.8	.....	4.7	.....	7.85	.....	7.55	3.1	.....	3.3	.....	3.5

Station rating table for Brazos River at Waco, Tex., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	62	3.70	820	5.80	2,955	9.50	9,200
2.10	82	3.80	900	6.00	3,220	10.00	10,260
2.20	104	3.90	980	6.20	3,490	10.50	11,360
2.30	128	4.00	1,065	6.40	3,770	11.00	12,510
2.40	145	4.10	1,150	6.60	4,055	11.50	13,700
2.50	184	4.20	1,235	6.80	4,345	12.00	14,900
2.60	215	4.30	1,320	7.00	4,645	12.50	16,150
2.70	248	4.40	1,410	7.20	4,955	13.00	17,450
2.80	284	4.50	1,500	7.40	5,275	13.50	18,800
2.90	323	4.60	1,595	7.60	5,605	14.00	20,200
3.00	365	4.70	1,695	7.80	5,945	14.50	21,660
3.10	410	4.80	1,795	8.00	6,300	15.00	23,180
3.20	460	4.90	1,900	8.20	6,660	16.00	26,400
3.30	520	5.00	2,005	8.40	7,030	17.00	29,850
3.40	590	5.20	2,225	8.60	7,410	18.00	33,500
3.50	665	5.40	2,455	8.80	7,790		
3.60	740	5.60	2,700	9.00	8,190		

The above table is based on discharge measurements made during 1900 to 1905 and is well defined.

Estimated monthly discharge of Brazos River at Waco, Tex., for 1905.

[Drainage area, 30,750 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	2,340	184	388	23,860	0.013	0.015
February	1,952	248	585	32,490	.019	.020
March	6,570	410	1,642	101,000	.053	.061
April	50,400	1,065	7,347	437,200	.239	.267
May	85,500	2,225	18,280	1,124,000	.594	.685
June	16,280	1,277	3,898	231,900	.127	.142
July	30,210	1,235	5,771	354,800	.188	.217
August	5,605	410	2,276	139,900	.074	.085
September	8,090	323	1,906	113,400	.062	.069
October	5,522	365	1,561	95,980	.051	.059
November	2,005	266	718	42,720	.023	.026
December	2,515	284	931	57,240	.030	.035
The year	85,500	184	3,775	2,754,000	.123	1.68

BRAZOS RIVER AT RICHMOND, TEX.

This station was established January 1, 1903, by Thomas U. Taylor. It is located at the bridge of the Southern Pacific Railroad.

The channel is straight for 200 feet above and 900 feet below the station, and has a width of about 175 feet at low water, without piers, and about 500 feet at ordinary high water, broken by three piers. During very high floods the left bank overflows and the width of the stream is 900 feet. The bed of the stream is sandy except around the piers, where it is stony, and is slightly shifting. The current is obstructed somewhat by old piles. Above and at Waco the river rises rapidly, and when it gets above gage height 30 feet overflows the bottom lands below the town. When

the floods spread out over the bottom lands, as they do from Waco to Richmond, the river stays up longer in its lower stretches than it does in the upper sections, as the bottoms and the lowlands serve as storage reservoirs for the backwater and are drained slowly as the river recedes. Above Waco the surface water rushes off into the stream more rapidly, and the river rises more suddenly and falls almost as suddenly. For this reason it is possible for the maximum discharge at Waco to be greater than it is at Richmond.

Discharge measurements are made from the bridge. The initial point for soundings is the east face of the pier under the west end of the middle span.

A standard chain gage is attached to the bridge; length of chain, 53.82 feet. During 1905 the gage was read once each day by J. E. Winston. Bench marks were established as follows: (1) The top of the tie at the downspout of the gage box in the central panel of the middle span on the downstream side of the bridge; elevation, 51.52 feet. (2) A point marked "R. F." on the southeast corner of the tie seat of west abutment; elevation, 51.11 feet. (3) The top of the north bolt in flange of hydrant at corner of Railroad and First streets, 6 inches below the top of the hydrant; elevation, 47.26 feet. (4) The top of the northeast corner of base stone of "Our Heroes" monument in the court-house square; elevation, 53.52 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 147; 99, p 329; 132, pp 32-33.
Discharge: 84, p 147; 99, p 330; 132, p 33.
Discharge, monthly: 99, p 332; 132, p 35.
Gage heights: 99, pp 330-331; 132, p 33.
Rating table: 99, p 331; 132, p 34.

Discharge measurements of Brazos River at Richmond, Tex., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 25	T. U. Taylor	9.1	9,400
August 4	do	8.4	7,960

Daily gage height, in feet, of Brazos River at Richmond, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	6.1	5.6	10.1	28.1	18.1	19.5	13.6	3.4	3.1	3.4	3.1
2	3.2	6.0	5.4	9.9	28.2	18.1	19.1	10.3	3.3	3.0	3.2	3.0
3	4.1	5.8	4.8	9.2	28.3	15.1	18.9	9.3	3.4	3.0	3.3	3.0
4	2.9	5.6	3.6	15.9	30.2	14.0	17.4	8.4	3.4	4.9	3.2	3.1
5	2.7	5.1	6.0	18.1	31.9	13.8	17.1	7.8	3.6	2.5	3.2	3.2
6	2.6	6.1	9.7	17.1	33.0	13.6	15.6	7.8	3.0	2.5	3.3	3.2
7	2.3	5.9	10.1	15.0	32.9	13.5	15.2	6.2	2.6	2.5	3.4	3.3
8	2.6	6.0	9.5	13.2	32.2	11.8	14.8	6.3	2.6	2.5	3.6	3.3
9	3.1	6.1	8.8	12.0	31.2	11.5	14.5	6.35	2.6	2.6	3.7	3.5
10	3.1	6.0	11.9	11.7	32.1	11.0	14.3	6.5	2.6	2.8	3.8	3.3
11	3.1	6.1	11.4	11.1	31.1	11.0	14.3	6.7	2.6	3.2	4.0	3.2
12	3.1	5.6	10.9	10.9	31.0	9.9	14.2	7.0	2.6	3.4	4.1	3.3
13	3.1	6.1	10.6	10.8	31.3	8.6	14.1	7.1	4.3	3.2	4.2	3.3
14	3.1	6.4	9.6	10.6	31.5	9.1	14.0	6.0	4.8	3.2	4.2	3.4
15	3.1	6.3	7.7	10.1	31.5	8.6	14.0	5.1	5.7	3.2	4.3	3.5
16	3.1	8.0	10.1	9.1	31.8	8.4	13.8	5.2	6.2	3.2	4.3	3.7
17	3.6	10.6	8.3	8.1	32.1	8.2	13.0	5.4	6.5	3.2	4.5	4.6
18	5.4	10.8	11.1	8.0	32.1	8.2	11.3	5.1	6.7	3.2	4.5	6.3
19	3.9	9.8	16.1	7.8	31.6	8.2	11.1	4.9	7.0	3.2	4.3	8.0
20	3.8	10.1	17.1	5.0	31.65	8.3	10.8	4.7	6.3	3.1	4.2	8.4
21	3.5	9.1	17.1	2.8	28.6	8.2	9.7	4.0	4.3	3.1	4.0	8.4
22	3.0	9.3	15.4	2.5	28.6	8.4	9.2	4.0	4.4	4.2	3.8	8.7
23	2.8	10.1	13.9	2.1	29.0	9.9	9.1	4.0	4.6	5.7	3.5	8.8
24	3.0	7.8	14.9	2.2	27.8	11.8	9.1	4.0	5.3	6.3	3.6	8.0
25	3.0	7.1	13.3	20.1	25.7	11.8	9.1	4.0	5.3	7.1	3.4	7.1
26	5.1	5.9	12.8	20.6	25.5	12.1	6.5	4.0	4.2	6.8	3.4	7.3
27	6.1	5.0	10.8	21.7	25.0	22.0	8.0	3.9	4.4	5.3	3.3	7.5
28	6.1	5.1	9.1	23.6	24.7	20.8	11.4	3.9	4.2	4.8	3.3	7.3
29	6.0	.....	10.7	23.5	20.9	20.3	13.7	3.8	4.2	4.5	3.3	7.1
30	5.9	.....	13.4	25.1	18.3	19.9	14.3	3.6	3.4	4.3	3.1	6.1
31	6.1	.....	11.7	.....	18.1	.....	14.4	3.4	.....	4.0	.....	6.4

Station rating table for Brazos River at Richmond, Tex., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	820	3.00	1,820	4.50	3,310	7.00	6,500
1.60	870	3.10	1,910	4.60	3,420	7.20	6,780
1.70	920	3.20	2,000	4.70	3,530	7.40	7,060
1.80	980	3.30	2,090	4.80	3,640	7.60	7,350
1.90	1,040	3.40	2,180	4.90	3,760	7.80	7,650
2.00	1,100	3.50	2,270	5.00	3,880	8.00	7,950
2.10	1,160	3.60	2,370	5.20	4,120	8.50	8,700
2.20	1,220	3.70	2,470	5.40	4,360	9.00	9,480
2.30	1,290	3.80	2,570	5.60	4,600	9.50	10,280
2.40	1,360	3.90	2,670	5.80	4,860	10.00	11,120
2.50	1,430	4.00	2,770	6.00	5,120	10.50	12,020
2.60	1,500	4.10	2,870	6.20	5,380	11.00	13,020
2.70	1,580	4.20	2,980	6.40	5,660	11.50	14,120
2.80	1,660	4.30	3,090	6.60	5,940	12.00	15,270
2.90	1,740	4.40	3,200	6.80	6,220	13.00	17,590

The above table is based on discharge measurements made during 1902–1905, and it is well defined. Above gage height 13 feet the rating curve is a tangent, the difference being 240 per tenth. Above 10 feet this table is the same as the 1903 table.

Estimated monthly discharge of Brazos River at Richmond, Tex., for 1905.

[Drainage area, 44,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	5,250	1,290	2,594	159,500	0.059	0.0[illegible]
February	12,620	3,880	6,742	374,400	.153	.1[illegible]
March	27,430	2,370	13,380	822,700	.304	.3[illegible]
April	46,630	1,160	17,680	1,052,000	.402	.4[illegible]
May	65,590	29,830	55,690	3,424,000	1.27	1.46
June	39,190	8,250	17,070	1,016,000	.388	.43
July	33,190	5,800	18,680	1,149,000	.425	.49
August	19,030	2,180	5,290	325,300	.120	.1[illegible]
September	6,500	1,500	3,169	188,600	.072	.08[illegible]
October	6,640	1,430	2,665	163,900	.061	.06[illegible]
November	3,310	1,910	2,498	148,600	.057	.06[illegible]
December	9,160	1,820	4,465	274,500	.101	.116
The year	65,590	1,160	12,490	9,098,000	.284	3.[illegible]

COLORADO RIVER (OF TEXAS) DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Colorado River rises in the extreme western portion of the State, within a few miles of the eastern boundary of New Mexico, and flows in a general southeasterly direction, emptying into the Gulf of Mexico in Matagorda County. The drainage area above Austin is 37,000 square miles and above Columbus 40,000 square miles, and it extends into the corner of New Mexico. Its main tributaries are the Concho, the San Saba, and the Llano. The Concho has a reliable flow and contributes a greater amount of water than the Colorado at their junction. The Concho furnishes water for irrigation and water power and supports in Irion and Tom Green counties some excellent irrigation systems, described in Water-Supply Paper No. 71. San Saba and Llano rivers are described in the same paper.

The Colorado at Austin emerges from a canyon. From Austin to the Gulf it traverses a rather flat country, and its waters are utilized for many power plants; 60,000 acres of rice were sowed during the season of 1902 in the counties of Colorado, Wharton, and Matagorda, under canals that obtained their water from the Colorado.

COLORADO RIVER AT AUSTIN, TEX.

This station was established December 21, 1897. It was originally located at the dam near Austin, Tex. On the failure of this dam the station was removed to the Congress Avenue Bridge, south of the city.

The channel is straight for 400 feet above and below the station. The velocity is moderately rapid. Neither bank has overflowed since the dam was washed away. The bed of the stream is composed of sand and is slightly shifting.

Discharge measurements are made by means of a cable and car 3 miles above Congress Avenue Bridge, about one-eighth mile above the ruins of the Austin dam and power house. The cable has a span of about 730 feet, but the width of the river at low water is less than half this distance.

Gage heights were first taken on the crest of the Austin dam August 13, 1895, and were continued from that date until the failure of the dam occurred in April, 1900. A staff gage consisting of upright posts driven into the bank of the river is located

near the bath house about 150 feet above the bridge. For higher gage heights the first pier from the north has been marked up to 40.00 feet. A standard chain gage is attached to the bridge at the same datum. During 1905 the gage was read twice each day by W. Peterson. Bench marks were established as follows: (1) A United States Coast and Geodetic Survey copper bolt on the top of the west end of the south pier of Congress Avenue Bridge, 475 feet above mean sea level and 48.00 feet above the datum of the gage. (2) A similar bolt in the southwest wall of the post-office at Austin, 508 feet above mean sea level; elevation, 81.00 feet above the datum of the gage. (3) On the first flange above the cribwork of the north pier of the bridge, marked "U. S. G. S. B. M. 4.78"; elevation, 4.78 feet above gage datum and 431.78 feet above mean sea level.

The low-water level at this point has been gradually falling for over a year. This has been caused by the erosion of the channel about 200 yards below the highway bridge. Under the highway bridge the water spreads out into a large pool, the outlet of which is through two contracted sections below, the main one of which being the one in which the erosion has taken place. The lowest level that the water has reached yet has been 0.70 foot by gage, but the corresponding discharge was no less than the minimum of 1902.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 140, pp 82-83; WS 28, pp 118-119; 37, p 274; 50, pp 336-337; 66, p 64; 84, pp 149-150; 99, p 334; 132, p 36.

Discharge: Ann 18, iv, p 110; Bull 140, p 83; WS 28, p 129; 37, p 274; 50, p 337; 66, p 64; 84, p 150; 99, p 335; 132, p 37.

Discharge, monthly: WS 75, p 152; 84, p 152; 99, p 336; 132, p 39.

Gage heights: WS 28, pp 122-124; 37, p 275; 50, p 338; 66, p 64; 84, p 151; 99, p 335; 132, p 38.

Hydrograph: WS 75, p 152.

Rating tables: WS 66, p 173; 84, p 151; 99, p 336; 132, p 39.

Discharge measurements of Colorado River at Austin, Tex., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Second-feet.*
July 15	H. H. Fox	2.7	1,760
July 17	do	2.2	1,111
July 21	do	1.7	520
August 19	do	1.1	240
September 3	do	.8	176
September 16	T. U. Taylor	.8	171

Daily gage height, in feet, of Colorado River at Austin, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.2	1.3	1.8	7.9	2.75	2.25	4.2	0.8	1.25	1.0	1.0
2	1.25	1.2	1.3	1.85	6.75	3.7	2.05	3.2	.85	1.15	1.1	1.0
3	1.2	1.2	1.25	2.95	5.35	3.15	1.85	2.75	.8	1.1	1.1	1.0
4	1.2	1.2	1.2	5.5	4.55	2.9	2.0	2.6	.8	1.0	1.1	1.0
5	1.2	1.2	1.2	4.8	4.2	2.65	1.8	2.45	1.0	1.0	1.1	1.0
6	1.2	1.2	1.2	3.5	3.85	2.5	1.7	2.4	1.25	1.0	.95	1.0
7	1.2	1.2	1.25	5.1	3.55	2.5	2.6	2.3	1.0	1.3	1.0	1.0
8	1.2	1.2	1.65	3.75	3.35	2.35	3.3	2.15	.9	2.15	1.0	1.0
9	1.2	1.2	1.6	3.05	10.5	2.2	4.0	1.85	.8	2.95	1.25	1.0
10	1.2	1.2	1.5	2.75	7.85	2.1	4.65	1.55	.8	2.45	1.85	1.0
11	1.2	1.2	1.5	2.55	6.6	2.0	3.95	1.9	.85	2.2	2.4	1.0
12	1.2	1.2	1.6	2.5	4.95	1.9	3.6	1.8	.95	2.05	2.9	1.0
13	1.2	1.6	1.65	2.4	3.9	1.8	3.25	1.65	.9	1.95	2.7	1.25
14	1.3	1.15	1.6	2.4	3.6	1.8	3.05	1.5	.8	1.75	2.25	1.15
15	1.3	1.25	1.6	2.3	4.75	1.8	2.7	1.35	.8	1.55	1.95	1.0
16	1.25	1.15	1.75	2.15	7.6	2.2	2.4	1.3	.8	1.45	1.75	1.0
17	1.2	1.2	2.95	2.0	8.1	2.3	2.2	1.2	1.7	1.3	1.65	1.0
18	1.2	1.25	3.3	2.0	5.6	2.25	2.05	1.2	2.5	1.3	1.4	1.1
19	1.25	1.3	5.7	1.85	3.9	1.9	1.9	1.15	2.2	1.2	1.3	1.5
20	1.2	1.3	3.75	1.8	3.25	1.8	1.8	1.05	2.05	1.3	1.2	1.5
21	1.2	1.3	3.55	1.8	3.0	1.7	1.7	1.0	2.4	2.2	1.2	1.6
22	1.2	1.4	3.55	1.8	2.85	1.75	1.65	1.0	2.15	3.35	1.1	1.5
23	1.2	1.5	3.0	1.7	2.6	2.0	1.55	1.0	1.9	2.55	1.1	1.4
24	1.2	1.5	2.6	4.25	2.55	1.9	1.45	.9	1.8	2.05	1.1	1.6
25	1.2	1.4	2.5	9.2	4.75	3.2	1.4	.9	1.9	1.7	1.1	1.6
26	1.2	1.4	2.4	7.3	4.55	3.15	1.4	.82	1.8	1.45	1.1	1.4
27	1.2	1.4	2.25	6.25	4.45	2.85	1.3	.8	1.7	1.3	1.1	1.2
28	1.15	1.3	2.15	5.75	3.7	2.7	1.3	.8	1.57	1.25	1.1	1.15
29	1.1	.....	2.05	7.65	3.5	2.7	1.8	.9	1.5	1.2	1.05	1.0
30	1.1	.....	1.9	15.05	3.9	2.5	3.6	.9	1.4	1.2	1.0	1.3
31	1.1	.....	1.9	.....	3.35	.....	5.95	.9	.....	1.15	.....	1.2

Station rating table for Colorodo River at Austin, Tex., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	175	1.90	790	3.00	2,260	4.20	5,170
.90	195	2.00	885	3.10	2,450	4.40	5,810
1.00	220	2.10	990	3.20	2,650	4.60	6,510
1.10	250	2.20	1,105	3.30	2,860	4.80	7,270
1.20	290	2.30	1,225	3.40	3,070	5.00	8,080
1.30	340	2.40	1,345	3.50	3,290	5.20	8,920
1.40	400	2.50	1,470	3.60	3,530	5.40	9,760
1.50	470	2.60	1,605	3.70	3,780	5.60	10,600
1.60	540	2.70	1,750	3.80	4,040	5.80	11,440
1.70	620	2.80	1,910	3.90	4,310	6.00	12,280
1.80	700	2.90	2,080	4.00	4,580	6.20	13,130

The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 0.8 foot and 6 feet. Above gage height 6.1 feet the rating curve is a tangent, the difference being 430 per tenth.

Estimated monthly discharge of Colorado River at Austin, Tex., for 1905.

[Drainage area, 37,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	340	250	293	18,020	0.0079	0.0091
February	540	270	335	18,600	.0091	.0095
March	11,020	290	1,461	89,830	.039	.045
April	51,190	620	6,557	390,200	.177	.198
May	31,620	1,537	8,267	508,300	.223	.257
June	3,780	620	1,404	83,540	.038	.042
July	12,070	340	1,949	119,800	.053	.061
August	5,170	175	775	47,650	.021	.024
September	1,470	175	488	29,040	.013	.014
October	2,965	220	689	42,360	.019	.022
November	2,080	207	505	30,050	.014	.016
December	540	220	299	18,380	.0081	.0093
The year	51,190	175	1,918	1,396,000	.052	.707

COLORADO RIVER AT COLUMBUS, TEX.

This station was established in December, 1902, by Thomas U. Taylor. It is located at the highway bridge east of Columbus.

The channel is straight for 200 feet above and 600 feet below the bridge, and has a width of 140 feet at low water, unobstructed by piers, and a width of 450 feet at ordinary high water, broken by two piers. At very high stages the left bank overflows for several hundred feet, but the water passes under the iron trestle approach to the bridge. The bed is composed of gravel and sand and is fairly permanent.

Discharge measurements are made from the three-span highway bridge at which the gage is located.

A gage is marked on the downstream side of the pier on the west side of the river. Gage datum is taken at 50 feet below the top of this pier, and the observer, W. E. Bridge, measures down from this point with a tagged chain and lead weight. Bench marks were established as follows: (1) The top of pier at the west end of the middle span of the bridge; elevation, 50.00 feet. (2) The east end of the top of the top stone step at the south door of the Columbus jail; elevation, 53.22 feet. (3) The north end of the top stone step at the east door of the Columbus court-house; elevation, 53.91 feet. (4) The top of the rail over the extreme west pier of the Southern Railway bridge crossing the river above the gaging station; elevation, 51.13 feet. Elevations refer to the datum of the gage.

A measurement made at this station August 5, 1905, by T. U. Taylor gave the following results: Gage height, 10.8 feet; discharge, 3,820 second-feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 149; 99, pp 332–333; 132, p 40.
Discharge: 84, p 149; 99, p 333; 132, p 40.
Discharge, monthly: 132, p 42.
Gage heights: 99, pp 333–334; 132, p 41.
Rating table: 132, p 42.

Daily gage height, in feet, of Colorado River at Columbus, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.45	5.8	6.4	7.9	30.75	12.25	10.5	7.5	6.8	7.3	7.7	7.0
2	6.4	5.8	6.3	8.9	33.0	12.1	10.05	14.15	6.8	7.2	7.7	6.9
3	6.4	6.0	6.2	14.1	30.7	11.3	9.6	13.5	7.2	7.15	6.9	6.75
4	6.4	6.0	6.2	11.4	21.15	11.15	10.05	11.85	7.1	7.1	6.9	6.7
5	6.2	5.8	6.0	9.1	17.4	11.85	10.25	10.6	6.9	7.05	6.9	6.7
6	6.2	5.8	6.0	13.55	15.6	11.05	9.65	9.75	6.8	7.0	6.9	6.6
7	6.2	5.8	6.0	13.2	14.3	10.4	8.9	9.05	6.8	6.9	7.15	6.5
8	6.2	5.8	10.5	11.95	13.25	9.9	8.55	8.55	6.8	6.9	7.0	6.5
9	6.0	6.0	12.45	14.0	12.6	9.6	11.75	8.35	6.8	6.75	8.5	6.5
10	6.0	6.1	11.4	12.35	16.6	9.55	14.8	8.5	6.9	6.7	9.05	6.6
11	6.0	6.2	9.55	11.0	24.5	9.4	15.0	8.5	6.9	6.6	8.4	6.6
12	6.0	6.2	8.4	10.25	21.75	9.1	14.0	8.2	6.8	9.05	7.8	6.6
13	6.0	6.4	7.85	9.7	17.95	8.65	12.85	8.1	6.7	8.7	7.5	7.8
14	7.2	6.4	7.35	8.7	16.8	8.65	12.2	8.1	6.65	8.15	8.0	7.6
15	7.05	6.2	9.5	9.05	21.1	8.5	11.3	8.0	6.6	8.05	8.0	7.25
16	6.4	6.2	14.45	8.75	18.25	8.5	10.95	7.75	6.6	7.7	8.45	7.1
17	6.4	6.0	10.1	8.65	17.0	8.45	10.4	7.55	6.6	7.6	8.35	7.1
18	6.2	5.9	13.9	8.5	22.75	8.95	9.7	7.5	6.6	7.6	7.9	7.0
19	6.2	15.5	18.5	8.35	20.2	9.35	9.2	7.5	6.6	7.3	7.6	8.2
20	6.2	12.0	16.0	8.1	16.05	9.25	8.6	7.25	6.6	7.3	7.45	8.4
21	6.0	9.75	15.6	8.0	13.8	8.9	8.6	7.4	7.25	7.2	7.4	8.1
22	6.0	8.25	18.75	7.85	12.1	9.5	8.5	7.2	8.1	7.2	7.35	7.6
23	6.1	7.5	14.9	7.7	11.8	11.75	8.3	7.05	8.05	7.15	7.2	7.3
24	6.1	6.85	16.6	22.25	14.75	9.4	8.15	7.0	8.15	7.45	7.1	7.2
25	6.0	6.65	11.05	24.45	13.25	8.5	8.1	6.95	8.35	9.85	7.1	8.0
26	6.0	6.55	10.25	24.25	12.3	10.8	8.05	6.9	7.9	9.2	7.15	7.5
27	5.95	6.4	9.65	21.65	12.35	24.75	8.0	6.95	7.65	7.9	7.45	7.3
28	5.85	6.4	9.15	19.0	14.25	17.0	8.0	6.85	7.45	7.7	7.1	6.95
29	5.8	.....	11.4	18.35	13.6	13.25	7.7	6.8	7.5	7.5	7.1	6.9
30	5.85	.....	9.2	26.25	12.7	11.5	7.6	6.8	7.5	7.3	7.0	7.0
31	5.8	.....	8.25	.....	12.45	.....	7.6	6.8	.....	7.2	.....	7.0

Station rating table for Colorado River at Columbus, Tex., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.40	510	7.30	1,460	9.40	2,850	13.50	6,160
5.50	550	7.40	1,520	9.60	2,990	14.00	6,610
5.60	590	7.50	1,580	9.80	3,130	14.50	7,090
5.70	630	7.60	1,640	10.00	3,270	15.00	7,590
5.80	680	7.70	1,700	10.20	3,410	16.00	8,660
5.90	730	7.80	1,760	10.40	3,570	17.00	9,860
6.00	780	7.90	1,820	10.60	3,730	18.00	11,140
6.10	830	8.00	1,880	10.80	3,890	19.00	12,520
6.20	880	8.10	1,940	11.00	4,050	20.00	13,970
6.30	930	8.20	2,010	11.20	4,210	21.00	15,470
6.40	980	8.30	2,080	11.40	4,370	22.00	17,030
6.50	1,030	8.40	2,150	11.60	4,530	23.00	18,700
6.60	1,080	8.50	2,220	11.80	4,690	24.00	20,420
6.70	1,130	8.60	2,290	12.00	4,850	25.00	22,200
6.80	1,180	8.70	2,360	12.20	5,010	26.00	24,070
6.90	1,230	8.80	2,430	12.40	5,170	27.00	25,980
7.00	1,280	8.90	2,500	12.60	5,350	28.00	27,920
7.10	1,340	9.00	2,570	12.80	5,530		
7.20	1,400	9.20	2,710	13.00	5,710		

The above table is based on discharge measurements made during 1902–1905. It is well defined.

Estimated monthly discharge of Colorado River at Columbus, Tex., for 1905.

[Drainage area, 40,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,400	680	895	55,030	0.022	0.025
February	8,110	680	1,044	57,980	.026	.027
March	12,180	780	4,115	253,000	.103	.119
April	24,550	1,700	6,775	403,100	.169	.189
May	37,900	4,690	11,830	727,400	.296	.341
June	21,750	2,185	4,194	249,600	.105	.117
July	7,590	1,640	3,303	203,100	.083	.096
August	6,745	1,180	2,166	133,200	.054	.062
September	2,115	1,080	1,366	81,290	.034	.038
October	3,165	1,080	1,622	99,730	.041	.047
November	2,605	1,230	1,611	95,860	.040	.045
December	2,150	1,080	1,377	84,670	.034	.039
The year	37,900	680	3,358	2,444,000	.084	1.14

SAN SABA RIVER NEAR SAN SABA, TEX.

San Saba River rises in two springs near Fort McKavett, in the western part of Menard County, Tex., and flows in an easterly direction for over 100 miles to its junction with Colorado River (of Texas). It is fed by many springs between Fort McKavett and Menardville, the largest of which is the one that feeds or is the source of Clear Creek.

A gaging station was established on San Saba River at the suspension bridge, 1 mile northwest of the town of San Saba, Tex., December 30, 1904, by E. C. H. Bantel. The drainage area above the town of San Saba is 3,000 square miles.

Sixteen miles above the gaging station the river issues from the canyon section of the river and emerges into a very rich valley that offers exceptional advantages for irrigation. There are about 40,000 acres that could be brought under a supplemental irrigation system, and the water supply of the San Saba River at this point becomes of the utmost importance. The low-water flow at the "Narrows," 17 miles above the town of San Saba, is about 25 second-feet, and any irrigation on an extensive scale will have to be done by means of an impounding dam, which can be constructed across the river near the ranch of Hilliard Doran, forming the reservoir in the canyon section of the river. Four miles above the town of Menardville the Noyes ditch takes out the larger supply of water from the river and diverts it into an irrigation system that extends through Menardville and to a point 5 miles below. Two other smaller ditches below San Saba, the Maimee and the Kitchen, divert practically all the remainder of the low flow into irrigation systems. In addition to the gravity systems there are several pumping plants along the stream from Fort McKavett to the head of the canyons, about 12 miles below Menardville. Thus in dry times about the only water that could be relied on for a big irrigation system in the San Saba Valley would be the water that could be stored by an impounding reservoir. The topography, the flood discharges, the excellent site for a dam, the nearness of stone, the absence of alkali in the water, and the richness of the soil all point to the fact that this valley offers one of the best and most feasible irrigation problems in the State of Texas.

The channel is straight for 150 feet above and 1,000 feet below the station. The current is swift at high and sluggish at low stages. Both banks are high, but liable to overflow at high stages. The bed of the stream is composed of sand and gravel. There is but one channel at all stages.

Discharge measurements are made from the suspension bridge. The initial point for soundings is the north face of the south pier.

The elevations of the water surface are determined by measuring down by means of a tape from a certain casting on the upstream face in the flooring of the bridge, the zero elevation being 40.00 feet below the same. Bench marks were established as follows: (1) A large wire nail driven into a tree 50 feet from the south end of the bridge; elevation, 37.63 feet. (2) A wire nail driven into a water elm 70 feet from the north end of the bridge, on the east side of the road; elevation, 37.16 feet. (3) A wire nail driven into a live oak tree 200 feet from the south end of the bridge and 50 feet from the edge of the stream; elevation, 37.16 feet. Elevations refer to the datum of the gage.

A measurement made at this station August 18, 1905, by T. U. Taylor, gave the following results: Gage height, 7.2 feet; discharge, 27 second-feet.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 132, United States Geological Survey, pp. 43–44.

Daily gage height, in feet, of San Saba River near San Saba, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.9	7.9	7.9	7.8	9.8	7.8	7.4	7.3	7.2	7.2	7.6	7.7
2	7.9	7.9	7.9	9.4	8.3	7.8	7.4	7.2	7.2	7.2	7.6	7.7
3	7.9	7.8	7.9	8.4	8.1	7.7	7.4	8.1	7.5	7.2	7.6	7.7
4	7.9	7.8	7.8	8.2	8.1	7.7	7.3	7.6	7.3	7.2	7.6	7.5
5	7.9	7.8	7.8	8.0	8.4	7.6	7.3	7.4	7.2	7.2	7.6	7.5
6	7.9	7.8	7.8	8.0	8.0	7.6	8.2	7.4	7.2	7.2	7.6	7.5
7	7.9	7.8	7.8	7.9	7.8	7.6	8.4	7.4	7.2	7.7	7.7	7.5
8	7.9	8.0	7.8	7.8	13.7	7.5	8.1	7.3	7.2	7.6	7.7	7.6
9	7.9	7.9	7.8	7.8	11.15	7.5	9.7	7.3	7.2	7.6	7.7	7.6
10	7.9	7.9	7.8	7.8	8.9	7.5	8.2	7.2	7.2	7.6	7.9	7.6
11	7.9	7.8	7.9	7.8	8.2	7.5	8.0	7.2	7.2	7.6	7.8	7.6
12	7.8	7.8	7.7	7.8	8.0	7.4	7.8	7.3	7.2	7.6	7.7	7.6
13	7.9	7.9	7.7	7.8	8.0	8.0	7.7	7.3	7.2	7.6	7.6	7.7
14	7.8	7.8	7.8	7.8	7.9	7.6	7.6	7.3	7.2	7.6	7.6	7.7
15	7.8	8.0	7.8	7.8	7.8	7.6	7.5	7.3	7.2	7.6	7.6	7.7
16	7.9	7.9	8.3	7.8	7.9	7.5	7.5	7.3	7.2	7.6	7.6	7.7
17	7.9	7.9	8.0	7.8	8.05	7.4	7.5	7.2	7.2	7.4	7.6	7.7
18	7.9	7.9	7.9	7.7	8.0	7.4	7.5	7.2	7.2	7.4	7.6	7.8
19	7.9	10.0	8.1	7.6	7.9	7.4	7.5	7.2	7.3	19.6	7.6	7.8
20	7.9	10.9	7.9	7.6	7.9	7.4	7.5	7.2	7.4	8.2	7.6	7.8
21	7.9	8.9	7.9	7.6	7.9	7.4	7.6	7.2	7.3	7.7	7.6	7.8
22	7.9	7.9	7.9	7.6	7.9	7.4	7.6	7.2	7.2	7.8	7.6	7.8
23	7.9	8.0	7.8	7.8	7.8	7.5	7.6	7.2	7.2	7.7	7.6	7.8
24	7.9	7.9	7.8	9.4	13.4	7.5	7.5	7.2	7.2	7.7	7.7	7.8
25	7.9	7.9	7.8	8.4	9.2	7.4	7.5	7.2	7.2	7.7	7.7	7.7
26	7.9	7.9	7.9	8.1	8.25	7.5	7.4	7.2	7.2	7.7	7.7	7.7
27	7.8	7.9	7.8	8.1	8.1	8.7	7.3	7.2	7.2	7.7	7.7	7.8
28	7.9	7.9	7.8	8.0	8.0	7.7	7.2	7.2	7.2	7.6	7.7	7.8
29	7.9	.....	7.8	7.8	7.8	7.5	7.3	7.2	7.2	7.6	7.7	7.8
30	7.9	.....	7.8	13.0	7.8	7.4	7.3	7.2	7.2	7.6	7.7	7.8
31	7.9	.....	7.8	.....	7.8	.....	7.4	7.2	.....	7.6	.....	7.8

BARTONS SPRINGS NEAR AUSTIN, TEX.

These springs are located about 2 miles from Austin and are similar in behavior and in flow to the Comal, San Felipe, and San Marcos. They respond in increased flow to the rainfall in the Edwards Plateau, but this response is always delayed for

some months. About a quarter of a mile from the head of the springs the Walsh spring was formerly active and operated a small mill, but it ceased flowing several years ago. In the wet season of 1900 it revived and continued flowing till the early part of 1901, when it again ceased, continuing dry till the early part of 1903. June 6, 1903, the flow of the Walsh spring was 8.5 second-feet, but it stopped flowing in the latter part of 1903 and has since remained dry.

Discharge measurements of Bartons Springs near Austin, Tex., 1894–1905.

Date.	Hydrographer.	Discharge.
		Second-feet.
1894	C. C. Babb	17
1895	do	25
March, 1898	T. U. Taylor	20
May, 1898	do	30
August, 1900	do	69
December, 1900	do	33
June, 1902	do	19
August, 1902	do	19
June, 1903	A. A. Cother	69
June, 1904	T. U. Taylor	43
July, 1905	H. H. Fox	65

GUADALUPE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Guadalupe River rises in the southern-central part of Texas, flows southeastward, and empties into San Antonio Bay. During the summer of 1902 its discharge was the least in its observed history, causing much loss above New Braunfels, where half a dozen power plants were forced to shut down or to run on short time. The flow at this time was so low that special efforts were made to obtain measurements at several points along its course.

GUADALUPE RIVER NEAR CUERO, TEX.

The Guadalupe, while the best water-power stream in Texas, has a drainage area above Cuero of only 5,100 square miles. Its efficiency is due almost entirely to the canal at New Braunfels. Below New Braunfels the largest tributary is San Marcos River.

This station was established by Thomas U. Taylor December 26, 1902. The original location was at the dam at Carl Buchel's power house, 3 miles north of Cuero, Tex. As it proved impossible to measure flood discharges at this point, a new station was established in July, 1903, at the bridge of the San Antonio and Aransas Pass Railroad 3 miles west of Cuero.

The channel is straight and has a width of 125 feet at low stages. The right bank is low and overflows for several hundred feet at high stages. The section is deep and the flow is sluggish. The bed is composed of soft material and may change somewhat.

Discharge measurements are made from the highway bridge, 200 feet below the railway bridge, when the gage is above 8 feet, but at lower stages the discharge is measured on the crest of the Buchel dam, 3 miles upstream, where the owners cooperate by shutting off the turbines and forcing the water over the crest of the dam. The crest of this dam is 140 feet long and 4 feet wide, and the depth of the water at the upper edge of the crest of the dam is about 1 foot. The discharge at this stage

was found to be 407 second-feet. In the usual weir formula, where $Q=c\ b\ h^{\frac{3}{2}}$, this would give a value of 2.9 for C. The initial point for soundings at the bridge is the east face of the tubular pier under the west end of the highway bridge.

A standard chain gage is attached to the bridge; length of chain, 46.20 feet. During 1905 the gage was read twice each day by Robert Miller, jr. Bench marks were established as follows: (1) The top of the tie in the third panel from the east end of the bridge; elevation, 50.00 feet. (2) The seat of the valve, about 100 feet from the pump house, on the line of pipe that leads from the pump to the water tank; elevation, 44.85 feet. (3) The top of a vertical iron rod buried in the ground 4 feet east of a mulberry tree near the left end of the bridge; elevation, 42.18 feet. Elevations refer to the datum of the gage.

A measurement made at this station August 5, 1905, by T. U. Taylor, gave the following results: Gage height, 6.3 feet; discharge, 754 second-feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 156; 99, p 337; 132, pp 45–46.
Discharge: 66, p 62; 99, p 338; 132, p 46.
Discharge, monthly: 99, p 340; 132, p 49.
Gage heights: 99, pp 338–339; 132, p 47.
Rating table: 99, p 339; 132, p 48.

Daily gage height, in feet, of Guadalupe River near Cuero, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.3	6.3	6.48	7.05	15.4	8.42	8.17	6.3	6.4	6.15	6.1	6.2
2	7.4	6.3	6.43	7.0	20.1	8.65	7.45	6.27	6.45	6.05	6.15	6.15
3	6.85	6.35	6.35	7.1	21.65	8.8	7.3	6.25	6.5	6.5	6.15	6.1
4	6.55	6.35	6.3	7.52	22.75	8.75	7.27	6.3	6.6	6.35	6.25	6.13
5	6.45	6.4	6.3	9.85	18.35	7.95	7.35	6.25	6.65	6.5	6.22	6.17
6	6.5	6.4	6.3	11.25	12.85	7.85	8.15	6.17	6.4	6.3	6.15	6.23
7	6.5	6.4	6.35	9.52	11.95	7.75	8.0	6.37	6.25	6.2	6.17	6.25
8	6.5	6.38	6.5	8.92	11.35	7.7	7.9	6.42	6.2	6.27	6.25	6.3
9	6.5	6.38	7.8	8.58	10.98	7.62	7.72	6.45	6.17	6.15	6.6	6.28
10	6.5	6.4	8.13	8.38	10.45	7.6	11.7	6.42	6.2	6.27	11.8	6.3
11	6.6	6.55	7.9	8.4	9.9	7.5	15.8	6.45	6.27	6.1	10.9	6.28
12	6.72	6.6	6.75	8.85	9.55	7.4	13.15	6.42	6.3	6.17	8.65	6.25
13	7.45	6.55	6.55	8.93	9.58	7.27	9.9	6.4	6.3	5.95	7.4	6.2
14	7.95	6.4	6.65	8.35	10.55	7.25	8.55	6.4	6.27	6.0	7.22	6.23
15	7.5	6.45	9.45	7.95	17.93	7.25	7.45	6.42	6.15	5.9	7.0	6.5
16	7.0	6.4	15.8	7.88	18.45	7.27	7.0	6.45	6.0	6.0	6.85	6.5
17	6.55	6.4	14.6	7.83	20.9	7.17	7.05	6.45	5.9	6.1	6.55	6.53
18	6.5	6.35	12.25	7.73	15.52	7.2	6.85	6.42	6.05	6.2	6.55	6.55
19	6.5	14.95	10.85	7.55	9.98	7.05	6.85	6.42	6.0	6.15	6.5	6.6
20	6.5	13.85	11.85	7.45	9.1	7.05	6.77	6.45	6.1	6.05	6.5	6.55
21	6.5	13.0	10.55	7.3	8.85	6.9	6.57	6.72	6.2	6.15	6.4	6.48
22	6.5	9.95	11.65	7.38	8.67	7.67	6.47	6.45	6.25	6.05	6.47	6.45
23	6.45	7.95	14.2	7.42	8.55	8.15	6.4	6.30	6.15	6.15	6.65	6.38
24	6.4	7.35	10.25	23.25	8.47	8.1	6.52	6.55	6.2	6.1	6.85	6.3
25	6.37	6.7	7.4	21.9	8.3	7.4	6.52	6.35	6.25	6.15	6.3	6.22
26	6.3	6.6	7.5	23.25	8.37	7.75	6.52	6.15	6.25	6.05	6.2	6.22
27	6.3	6.6	7.5	24.3	8.17	9.35	6.47	6.3	6.27	6.1	6.25	6.28
28	6.25	6.6	7.62	23.45	8.25	12.65	6.42	6.27	6.3	6.17	6.3	6.22
29	6.2	.....	7.92	24.9	8.37	14.87	6.4	6.25	6.25	6.1	6.35	6.15
30	6.2	.....	7.9	24.05	8.3	11.9	6.3	6.22	6.1	6.25	6.3	6.1
31	6.25	.....	7.5	.....	8.37	.....	6.27	6.27	.....	6.15	.....	6.15

Station rating table for Guadalupe River near Cuero, Tex., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	580	8.00	1,280	10.00	1,980	14.00	3,400
6.10	615	8.10	1,315	10.20	2,050	14.20	3,480
6.20	650	8.20	1,350	10.40	2,120	14.40	3,560
6.30	685	8.30	1,385	10.60	2,190	14.60	3,640
6.40	720	8.40	1,420	10.80	2,260	14.80	3,720
6.50	755	8.50	1,455	11.00	2,330	15.00	3,800
6.60	790	8.60	1,490	11.20	2,400	15.50	4,000
6.70	825	8.70	1,525	11.40	2,470	16.00	4,200
6.80	860	8.80	1,560	11.60	2,540	16.50	4,400
6.90	895	8.90	1,595	11.80	2,610	17.00	4,650
7.00	930	9.00	1,630	12.00	2,680	17.50	4,900
7.10	965	9.10	1,665	12.20	2,750	18.00	5,150
7.20	1,000	9.20	1,700	12.40	2,820	18.50	5,440
7.30	1,035	9.30	1,735	12.60	2,890	19.00	5,740
7.40	1,070	9.40	1,770	12.80	2,960	20.00	6,340
7.50	1,105	9.50	1,805	13.00	3,030	21.00	7,040
7.60	1,140	9.60	1,840	13.20	3,100	22.00	7,840
7.70	1,175	9.70	1,875	13.40	3,170	23.00	8,680
7.80	1,210	9.80	1,910	13.60	3,240	24.00	9,630
7.90	1,245	9.90	1,945	13.80	3,320	25.00	10,690

The above table is based on one discharge measurement made during 1905 and measurements prior to 1904. It is well defined. The above table was used for 1903.

Estimated monthly discharge of Guadalupe River near Cuero, Tex., for 1905.

[Drainage area, 5,100 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	2,085	650	840	51,650	0.165	0.190
February	3,780	685	1,094	60,780	.215	.224
March	4,120	685	1,530	94,080	.300	.346
April	10,580	930	3,192	189,900	.626	.698
May	8,455	1,340	2,997	184,300	.588	.678
June	3,748	895	1,378	82,000	.270	.301
July	4,120	674	1,207	74,220	.237	.273
August	832	632	708	43,530	.139	.160
September	808	545	666	39,630	.131	.146
October	755	545	631	38,980	.124	.143
November	2,610	615	884	52,600	.173	.193
December	790	615	684	42,060	.134	.154
The year	10,580	545	1,318	953,700	.258	3.51

COMAL RIVER AT NEW BRAUNFELS, TEX.

Comal River has been fully described in Water-Supply Papers, Nos. 71 and 105. Its source is in the numerous big springs that issue from the foothills west of New Braunfels, Tex. The joint discharge of these forms Comal River at the junction of Comal Springs Creek and Comal Creek. The water from the head springs naturally flows down Comal Springs Creek, but a gravel dam deflects part of this flow into the

Landa mill race. These waters again join about 4 miles above the highway bridge north of the court-house, forming Comal River. The following table shows the result of current-meter measurements on Comal River at various times:

Discharge measurements of Comal River at New Braunfels, Tex., 1895–1905.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
1895	C. C. Babb	328	At highway bridge.
1898	T. U. Taylor	320	Do.
1899	do	310	In park.
1900	do	374	Do.
1901	do	343	Do.
1902	do	333	Do.
1903	do	412	In park (recent rains).
1904	do	375	In park.
1905	do	390	Do.

SAN ANTONIO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

San Antonio River rises about 3 miles north of the mission of San Fernando, the geographic center of the city of San Antonio. The underground source of San Antonio River and of the artesian wells in the vicinity is the same. The flow of the headwaters is extremely variable, as is seen from the record at San Antonio.

SAN ANTONIO RIVER AT SAN ANTONIO, TEX.

About 1885 San Antonio River at San Antonio began to fail, and by the latter part of 1897 the flow above the city had entirely ceased. San Pedro Creek rises in San Pedro Park and has maintained a flow of 9 second-feet for several years. This joins San Antonio River just below the city and above the Hot Wells, where many of the measurements are made. This river has gone through the same experience as many of the big springs. There is no doubt that the river and the artesian wells have the same underground source, but the river regained its former efficiency in 1900 shortly after the celebrated flood (Water Supply Paper No. 105); in two years, however, the discharge has dropped to a third of the discharge in 1900. The following table shows the discharge measurements that have been made on this stream:

Discharge measurements of San Antonio River at San Antonio, Tex., 1895–1905.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
December, 1895	C. C. Babb	40	Upper canal.
November, 1896	do	41	Do.
December, 1897	T. U. Taylor	0	Lower canal.
December, 1897	do	11	Hot Wells.
March, 1898	do	0	Lower canal.
March, 1898	do	9	Hot Wells.
June, 1899	do	0	Lower canal.
June, 1899	do	10	Hot Wells.
September, 1900	do	103	Lower canal.
September, 1900	do	125	Hot Wells.
October, 1901	do	41	Do.
March, 1904	do	65	Do.
June, 1904	do	61	Do.
September, 1905	do	117	Do.

NUECES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The two main forks of Nueces River rise in Edwards County, Tex., and flows southward through the rugged mountains of the Edwards Plateau, uniting about 14 miles from Uvalde and about 6 miles above the crossing of the Southern Pacific Railroad. On their way through the mountains both branches are fed by springs and carry perpetually running water from their sources, about 12 miles south of Rock Springs to their junction at the foot of the Edwards Plateau. At about the junction of the branches the usual flow sinks into gravel beds, occasionally reappearing in big, clear pools at points where the gravel has been washed off from the solid bed-rock bottom. Four or five miles below the Southern Pacific Railroad bridge flowing water again appears, the stream along its low land course being fed by numerous springs.

LEONA RIVER AT UVALDE, TEX.

The flow of Leona River at Uvalde is variable and the river has often stopped flowing altogether near Uvalde. It was dry in 1885, but soon revived and continued flowing till 1893, when it again ceased for a time. Its history at the brickyard crossing, 1½ miles below the town on the road to Pearsall, is given in the following table:

Discharge measurements of Leona River at Uvalde, Tex., 1885–1905.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
1885			Flowed.
1893			Did not flow.
December, 1895	C. C. Babb	11	
June, 1899	T. U. Taylor		Do.
September, 1900	do	5	
March, 1904	do	22	
August, 1905	do	13	

RIO GRANDE DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The source of the Rio Grande is in the snow masses of the high peaks of the continental divide in Hinsdale and Mineral counties in southwestern Colorado. The main stream flows in an easterly direction for about 75 miles, receiving numerous tributaries from the mountainous region through which it passes. At Del Norte the stream channel leaves a narrow canyon-like valley and enters the San Luis Valley. From Del Norte the general course is southeasterly for about 75 miles to a point 20 miles east of Antonito, where it crosses the Colorado-New Mexico State line. Four miles above the State line the Rio Grande enters a canyon, locally known as the Rio Grande Canyon, and continues through it to a short distance below Embudo, N. Mex., where the canyon walls retreat rapidly, especially on the west side, giving room for a border of irregular hills between the higher mesa walls and the flood plain adjacent to the river. This is the beginning of Espanola Valley, about 3 or 4 miles in width, which extends to White Rock Canyon, about 25 miles below, and through which the Rio Grande flows for 30 miles. Again the canyon walls recede, and the river enters Albuquerque Valley, which averages from 1 to 3 miles in width and continues down to about Socorro, N. Mex. Throughout its course in New Mexico the general direction of the Rio Grande is southward to El Paso; thence it is southeasterly to the Gulf of Mexico.

From the high mountains which surround this basin come a large number of small streams, some of which unite into creeks of considerable size, while others sink and gradually disappear into the coarse soil of the valley bottom. Below Del Norte few streams of importance enter the river with the exception of the Chama in New Mexico and the Pecos in Texas, as nearly all those which issue from the mountains lose their water, except in flood periods, in the sandy plains before they reach the main channel. Rio Conchos is the principal tributary from the Mexican side.

The limited data on precipitation collected by the United States Weather Bureau show the mean annual rainfall to be 25 inches in the mountainous portion of the drainage. This diminishes to 10 inches in the foothills and lower portions of the drainage.

The determination of the amount of water in the Rio Grande is of importance, both on account of its use in irrigation and from its bearing upon interstate and international distribution of water. Most of the New Mexico and Texas stations down to Eagle Pass are maintained by the United States section of the International (Water) Boundary Commission. The data are collected by W. W. Follett, consulting engineer for the Commission, and have been furnished through the courtesy of Gen. Anson Mills, Commissioner. On account of the shifting character of the river beds at the International (Water) Boundary stations, no rating tables have been prepared. The estimated monthly discharges are from daily discharges computed by Mr. Follett directly from the discharge measurements.

The five stations from Laredo down (Laredo, Roma, Brownsville, Salado near Guerrero, and San Juan at Santa Rosalie Ranch) are maintained by the Mexican section of the Commission.

RIO GRANDE NEAR DEL NORTE, COLO.

Measurements and observations were first begun in the vicinity of Del Norte in 1889 by George T. Quinby. The object of the measurements was to obtain the flow of the river before water was diverted for the agricultural region of San Luis Valley, and by a comparison of this with the figures obtained at Embudo to acquire data as to the effect of the numerous ditches taking out water between the two points. The river 25 miles above Del Norte flows out of the canyon at Wagon Wheel Gap. Little water, however, is diverted until the edge of the San Luis Valley is reached, the largest canal heading near the town of Del Norte. During freshets the river divides into a number of channels, making it difficult to obtain measurements near town. In order to avoid the expense of establishing a station during time of high water the first measurements—those about June 1—were made from several bridges crossing the numerous branches. The results were not wholly satisfactory, and June 25 a station was established above the branches. Later a locality about 2 miles farther up was chosen. Records are continuous for a period of sixteen years.

The station is about 2 miles west of Del Norte, above the main canal taking water from the Rio Grande, and is above all the irrigating ditches of importance.

The stream course, which is of uniform section, is straight for 100 yards both above and below the cable. The bed is composed of small bowlders and cobblestones, and hitherto has been considered permanent. However, the high water of June, 1905, altered the section considerably along the right side. The present section will probably be permanent for a long period of years and can change only during extreme high water. The left bank is low and of gradual slope, and is composed of cobblestones and gravel with a fringe of small cottonwood trees, and overflows at high water. The right bank is 6 feet above low water, of about 45° slope, and is composed of bowlders, cobblestones, and gravel. The extreme high water of 1905 overflowed this bank and extended over the entire bottom land to the right for a distance of half a mile. There is but one channel at all stages, and it is about 75 feet wide and of very regular section. Gage heights range from 1 to 5 feet save at extreme high water. The current is swift at low water, and exceptionally so during high water. Very accurate results may be secured at this station.

Discharge measurements were first made from a flatboat controlled by a cable across the river. They are now made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is on the right bank of river, and is indicated by a tag on the tagged wire, 22 feet from the tree to which the cable is anchored.

Several inclined gages have been used from time to time. The datum of each has been the same, and the location practically so. The lower part of the present gage is an inclined rod at the cable, and the upper part a vertical post, on the right bank. During 1905 the gage was read once each day by Richard D. Adams. The bench mark is a United States Geological Survey iron bench mark post set in the ground 25 feet south of the gage; elevation, 8.25 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, pp 110-111; 18, iv, p 246; Bull 131, pp 41-42; 140, p 170; WS 16, p 127; 28, p 120; 37, pp 277-278; 50, p 347; 66, p 65; 84, pp 194-195; 99, pp 400-401; 132, p 52.

Discharge: Ann 18, iv, p 246; Bull 131, p 91; 140, p 170; WS 16, p 127; 28, p 129; 37, p 278; 50, p 347; 66, p 65; 84, p 195; 99, p 401; 132, p 53.

Discharge, monthly: Ann 11, ii, p 98; 12, ii, pp 349, 360; 13, iii, p 94; 14, ii, p 11; 18, iv, p 247-248; 19, iv, p 383; 20, iv, pp 358, 360-364; 21 iv, p 256; 22, iv, p 347; WS 75, p 153; 84, p 196; 99, p 402; 132, p 54.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 57.

Gage heights: Bull 131, pp 42-43; 140, p 170; WS 11, p 64; 16, p 127; 28, p 126; 37, p 278; 50, p 347; 66, p 65; 84, pp 195-196; 99, p 401; 132, p 53.

Hydrographs: Ann 12, ii, p 250; 18, iv, p 249; 19, iv, p 384; 20, iv, p 365; 21, iv, p 256; 22, iv, p 348.

Rainfall and run-off relation: Ann 20, iv, p 359.

Rating tables: Ann 18, iv, p 247; 19, iv, p 383; WS 28, p 130; 39, p 450; 52, p 519; 66, p 173; 84, p 196; 99, p 402; 132, p 54.

Discharge measurements of Rio Grande near Del Norte, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 20	R. I. Meeker	132	184	3.46	2.08	638
June 28	do	156	550	6.23	3.90	3,428
July 25	do	137	224	3.32	1.70	744
September 18	do	122	130	2.15	1.00	280

Daily gage height, in feet, of Rio Grande near Del Norte, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	3.8	6.25	3.2	1.95	1.2	1.9	1.1	1.0
2	1.45	3.9	6.7	3.05	1.9	1.2	1.6	1.1	1.0
3	1.5	3.2	6.9	2.9	1.9	1.2	1.5	1.1	1.0
4	1.45	2.9	7.0	2.75	1.8	1.25	1.5	1.1	1.0
5	1.45	2.8	7.05	2.55	1.85	1.25	1.4	1.1	1.0
6	1.55	2.6	6.1	2.35	1.9	1.3	1.4	1.1	1.0
7	1.7	2.7	6.2	2.3	1.9	1.25	1.35	1.1	1.0
8	1.8	2.9	6.45	2.25	1.85	1.2	1.3	1.1	1.0
9	2.5	3.4	6.4	2.2	1.75	1.2	1.25	1.1	1.0
10	2.5	3.25	6.3	2.15	1.6	1.25	1.25	1.1	1.0
11	2.1	2.8	6.0	2.1	1.7	1.2	1.2	1.1	1.0
12	2.0	2.9	5.9	2.0	1.75	1.15	1.2	1.0	1.0
13	1.95	3.1	5.7	2.0	1.6	1.1	1.2	1.0	1.0
14	2.0	3.1	5.7	1.95	1.55	1.1	1.2	1.0	1.0
15	2.1	3.7	5.65	1.95	1.45	1.1	1.2	1.0	1.0
16	2.15	4.2	5.55	1.8	1.4	1.05	1.2	1.0	1.0
17	2.15	4.9	5.2	1.85	1.35	1.0	1.2	1.0	1.0
18	2.1	5.1	5.0	1.85	1.3	1.0	1.25	1.0	1.0

Daily gage height, in feet, of Rio Grande, near Del Norte, Colo., for 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
19	2.3	5.6	4.8	1.9	1.25	1.0	1.25	1.0	1.0
20	2.1	5.7	4.7	1.9	1.25	1.0	1.2	1.0	1.0
21	2.5	5.5	4.6	1.95	1.2	1.0	1.2	1.0	1.0
22	2.15	5.8	4.2	2.0	1.15	1.0	1.2	1.0	1.0
23	2.2	6.2	4.1	1.9	1.15	1.0	1.2	1.0	1.0
24	2.1	6.0	4.0	1.8	1.2	1.0	1.2	1.0	1.0
25	2.1	6.5	3.85	1.7	1.3	1.1	1.2	.8	1.0
26	2.1	6.0	3.75	1.65	1.25	1.2	1.2	.8	1.0
27	2.4	5.9	3.45	1.6	1.25	1.15	1.2	.8	1.0
28	2.6	6.0	3.9	1.7	1.2	1.1	1.2	.9	1.0
29	3.0	4.5	3.65	1.8	1.25	1.05	1.2	1.0	1.0
30	3.25	4.9	3.5	2.15	1.3	2.27	1.15	1.0	1.0
31	.....	5.6	.....	2.0	1.25	.....	1.15	.....	1.0

Station rating table for Rio Grande near Del Norte, Colo., from April 1 to June 5, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	290	2.60	1,135	3.80	2,400	5.00	4,010
1.50	345	2.70	1,225	3.90	2,520	5.20	4,330
1.60	405	2.80	1,315	4.00	2,640	5.40	4,650
1.70	465	2.90	1,410	4.10	2,760	5.60	4,990
1.80	535	3.00	1,510	4.20	2,890	5.80	5,410
1.90	605	3.10	1,610	4.30	3,030	6.00	5,890
2.00	675	3.20	1,710	4.40	3,170	6.20	6,450
2.10	745	3.30	1,810	4.50	3,310	6.40	7,100
2.20	815	3.40	1,920	4.60	3,450	6.60	7,850
2.30	890	3.50	2,040	4.70	3,590	6.80	8,730
2.40	970	3.60	2,160	4.80	3,730	7.00	9,760
2.50	1,050	3.70	2,280	4.90	3,870		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made previous to the high water of June, 1905. It is not well defined. Below gage height 5.5 feet it is the same as the 1904 table.

Station rating table for Rio Grande near Del Norte, Colo., from June 6 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
[a]1.00	290	2.20	1,150	3.40	2,670	4.60	4,630
1.10	330	2.30	1,260	3.50	2,820	4.70	4,820
1.20	380	2.40	1,370	3.60	2,970	4.80	5,010
1.30	440	2.50	1,480	3.70	3,120	4.90	5,200
1.40	500	2.60	1,600	3.80	3,280	5.00	5,400
1.50	560	2.70	1,720	3.90	3,440	5.20	5,810
1.60	630	2.80	1,850	4.00	3,600	5.40	6,230
1.70	700	2.90	1,980	4.10	3,760	5.60	6,670
1.80	780	3.00	2,110	4.20	3,930	5.80	7,110
1.90	860	3.10	2,250	4.30	4,100	6.00	7,550
2.00	950	3.20	2,390	4.40	4,270	6.20	8,030
2.10	1,050	3.30	2,530	4.50	4,450	6.40	8,510

[a] 0.8 = 220; 0.9 = 255.

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905. Estimates based on this table are only approximate.

Estimated monthly discharge of Rio Grande near Del Norte, Colo., for 1905.

[Drainage area, 1,400 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	1,760	318	760	45,220	0.543	0.606
May	7,460	1,185	3,411	209,700	2.44	2.81
June	10,030	2,745	6,090	362,400	4.35	4.85
July	2,390	630	1,091	67,080	.779	.898
August	905	355	578	35,540	.413	.476
September	1,227	290	376	22,370	.269	.300
October	860	355	430	26,440	.307	.354
November	330	220	296	17,610	.211	.235
December	290	290	290	17,830	.207	.239
The period				804,200		

RIO GRANDE NEAR LOBATOS, COLO.

This station was established June 28, 1899, by A. L. Fellows, and is 13 miles east of Antonio, the nearest railroad station. It is located at the State highway bridge at a point near the Colorado-New Mexico State line, about 10 miles east of Lobatos post-office and in T. 33 N., R. 11 E. The record of flow at this station is of importance to the proposed Government irrigation project near Engle, N. Mex., and also from the fact that it gives the discharge of the river at the Colorado State line, so that it includes practically all of the Colorado drainage.

The cross section above and below the station is fairly uniform and the channel regular, being straight above and below for a considerable distance. The stream channel is a gash cut through the solid lava to a general depth of 40 feet at the bridge. The stream floor is fairly smooth, but is littered with angular fragments of lava that catch and hold a loose, shallow deposit of sand during low water, which prevails during the greater portion of the year. The right bank is a perpendicuar lava cliff. The left bank, composed of loose fragments of lava at the water's edge, slopes gradually up to the lava cliff. The channel can not overflow either bank at this section. At low stages there are usually two channels; during high water there is but one. Gage heights range from 1 to 10 feet. At low water the current is very sluggish; at high water very swift. The center pier obstructs the current very little during high water.

Discharge measurements at high water are made from the downstream side of the bridge, a double span steel structure with cylinder piers at the center of the stream and 300 feet in length.

The initial point for soundings is at the right end of the bridge, downstream side. At low water discharge measurements are made by wading either above or below the bridge.

The gage is a scale on the right side of the downstream pier of the bridge. During 1905 the gage was read twice each day by Román Mondragón. The bench mark is a chiseled point marked "B. M." on the face of the lava bluff at the west end of the bridge; elevation, 7.42 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 37, p 279; 50, pp 348-349; 66, p 65; 84, pp 192-193; 99, p 395; 132, p 55.
Discharge: WS 37, p 279; 50, p 349; 66, p 65; 84, p 193; 99, p 395; 132, p 55.
Discharge, monthly: Ann 21, iv, p 257; 22 iv, p 349; WS 75, p 153; 84, p 194; 99, p 397; 132, p 57.
Gage heights: WS 37, p 280; 50, p 349; 66, p 66; 84, p 193; 99, p 396; 132, p 56.
Hydrographs: Ann 21, iv, p 257; 22, iv, p 349.
Rating tables: WS 39, p 450; 52, p 519; 66, p 173; 84, p 193; 99, p 396; 132, p 56.

Discharge measurements of Rio Grande near Lobatos, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet per second.*	*Feet.*	*Sec.-feet.*
April 21	R. I. Meeker	234	433	1.85	2.45	801
June 23	do	249	1,029	3.23	4.25	3,343
July 26[a]	do	207	188	.36	1.12	67
September 22	do	200	166	.28	1.00	46

[a] Made by wading.

Daily gage height, in feet, of Rio Grande near Lobatos, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.75	3.00	2.0	3.6	6.25	2.9	1.25	1.2	1.0	1.3	1.9
2	2.6	2.8	3.15	2.0	4.4	6.5	2.7	1.35	1.1	1.0	1.3	1.9
3	2.6	2.8	3.2	2.0	4.65	7.05	2.55	1.7	1.15	1.0	1.3	1.9
4	2.6	2.8	3.2	2.0	4.55	7.85	2.2	1.7	1.2	1.5	1.4	1.9
5	2.6	2.8	3.2	1.95	4.25	8.25	2.1	1.7	1.2	1.5	1.4	1.9
6	2.6	2.8	3.15	1.9	3.65	8.75	2.0	1.7	1.2	1.4	1.4	1.9
7	2.6	2.8	2.1	1.9	3.45	8.85	1.85	1.6	1.2	1.5	1.4	1.9
8	2.6	2.8	2.3	1.9	3.3	9.05	1.7	1.6	1.2	1.5	1.5	1.9
9	2.6	2.8	2.5	1.95	3.4	8.85	1.6	1.65	1.2	1.4	1.5	1.9
10	2.6	2.8	2.5	2.05	3.55	8.6	1.5	1.6	1.2	1.4	1.5	2.0
11	2.6	2.8	2.5	2.1	3.7	8.45	1.4	1.6	1.2	1.3	1.6	2.0
12	2.6	2.8	2.6	2.4	3.5	8.1	1.4	1.6	1.2	1.3	1.6	2.0
13	2.6	2.8	2.6	2.4	3.4	7.6	1.4	1.6	1.1	1.2	1.6	2.05
14	2.6	2.8	2.5	2.4	3.6	6.8	1.3	1.45	1.1	1.2	1.6	2.2
15	2.6	2.8	2.4	2.3	3.6	6.7	1.3	1.4	1.1	1.2	1.6	2.2
16	2.6	2.8	2.45	2.2	4.1	6.4	1.3	1.35	1.1	1.1	1.6	2.2
17	2.6	2.8	2.45	2.25	4.7	6.3	1.3	1.3	1.0	1.1	1.6	2.2
18	2.6	2.8	2.45	2.3	5.1	6.05	1.3	1.3	1.0	1.1	1.6	2.2
19	2.6	2.8	2.4	2.4	5.9	5.8	1.3	1.3	1.0	1.1	1.6	2.2
20	2.6	2.8	2.4	2.5	6.6	5.15	1.2	1.2	1.0	1.1	1.6	2.2
21	2.6	2.8	2.4	2.5	7.0	4.9	1.2	1.2	1.0	1.1	1.6	2.2
22	2.6	2.8	2.3	2.55	7.2	4.5	1.2	1.2	1.0	1.1	1.6	2.2
23	2.6	2.8	2.2	2.6	7.7	4.0	1.2	1.2	1.0	1.1	1.6	2.2
24	2.6	2.8	2.1	2.6	7.95	3.65	1.2	1.2	1.0	1.1	1.7	2.2
25	2.6	2.8	2.0	2.6	8.0	3.55	1.2	1.2	1.0	1.1	1.7	2.2
26	2.6	2.8	2.0	2.6	8.4	3.5	1.2	1.3	1.0	1.1	1.7	2.2
27	2.6	2.8	2.0	2.6	8.15	3.5	1.2	1.2	1.0	1.2	1.7	2.2
28	2.6	2.85	2.1	2.7	8.0	3.3	1.2	1.2	1.0	1.3	1.9	2.2
29	2.6	.....	2.0	3.0	7.7	3.2	1.2	1.2	1.0	1.3	1.6	2.2
30	2.6	.....	2.0	3.3	7.1	3.0	1.2	1.2	1.0	1.3	1.85	2.2
31	2.6	.....	2.0	.....	6.7	.....	1.2	1.2	.....	1.3	.....	2.2

RIO GRANDE NEAR SAN ILDEFONSO, N. M.

This station was established February 3, 1895, by A. P. Davis, and is located at the Denver and Rio Grande Railroad bridge, 9 miles below Espanola and 2 miles from San Ildefonso. The station has been called by the following names: Rio Grande, Buckman, and Water Tank. The data at this station are of especial interest in connection with irrigation projects, owing to the fact that Mexican settlers of this valley divert a considerable volume of water for their cultivated lands. The method of application of water to land by these people is very wasteful. In recent years a number of important modern irrigation systems have been planned and built in the valley in the vicinity of Albuquerque, 40 miles below.

The channel is straight for 150 feet above and 500 feet below the cable. The bed of the stream at the cable is about 200 feet in width, and is composed of lava bowlders, with a shifting deposit of sand and silt, which scours out and changes during very high water and accumulates immediately on its recession. At low water ordinarily the channel finds a narrow passage through this deposit. The right bank is low and composed of lava bowlders with a silt deposit. It overflows at high water. The left bank is scattered with lava bowlders and is the steep side of a mountain partly covered with scattered cedars. There is but one channel at all stages. Gage heights range from 1.5 to 12 feet. During high water it is difficult to secure accurate measurements from the bridge on account of the high velocity of the current and the rough surface. In addition to this, the Denver and Rio Grande Railroad bridge does not cross the river at a right angle to the direction of the current.

At the cable section the water boils considerably at low water. At high water at both sections the velocity is close to 20 feet per second.

Discharge measurements are made from a cable with car and tag line 150 feet above the bridge, to which the gage is attached. At very high water measurements must be made from the railroad bridge. The initial point for soundings at the cable is at the end of the cable on the left side of the stream, where the cable is fastened to two small cedar trees.

The original gage at this station was located on the left bank, 180 feet above the bridge. The inclined portion read from 1 to 10 feet and the vertical portion from 10 to 16 feet. It was found that this gage was not well located, and March 30, 1904, a vertical rod was established on the downstream side of the north pier of the bridge, the datum being 2.019 feet higher than that of the original gage. During the flood of September, 1904, this rod was cut off from the water by the filling in of the channelr October 29, 1904, a standard chain gage was established on the downstream running board of the bridge, at the same datum as the new rod gage; length of chain, 23.28 feet. During 1905 the gage was read twice each day by Joseph Gomez. The bench mark is a United States Geological Survey tablet, set in the top of a granite bowlder, 5 feet square and 2 feet high, located in a clump of cedars on the right bank of the river, about 75 feet from the west end of the north pier of the railroad bridge; elevation, 11.37 feet above the datum of the new gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 252-253; Bull 140, pp 175-176; WS 16, p 130; 28, p 120; 37, pp 281-282; 50 pp 350-351; 66, p 67; 84, pp 186-187; 99, p 387; 132, pp 57-58.

Discharge: Ann 11, ii, p 107; Ann 18, iv, p 253; Bull 140, p 176; WS 16, p 130; 28, p 129; 37, p 282; 50, p 351; 66, p 67; 84, pp 187-188; 99, pp 387-389; 132, p 59.

Discharge, monthly: Ann 18, iv, p 254; 19, iv, p 386; 20, iv, pp 358, 370; 21, iv, p 259; 22, iv, p 351; Bull 140, p 177; WS 75, p 154; 84, p 189; 99, p 390; 132, p 62.

Discharge, yearly: Ann 20, iv, p 58.

Gage heights: Bull 140, p 176; WS 11, p 66; 16, p 130; 28, p 127; 37, p 282; 50, p 351; 66, p 68; 84, p 188; 99, pp 389-390; 132, p 60.

Hydrographs: Ann 18, iv, p 255; 19, iv, p 387; 21, iv, p 260; 22, iv, p 351.

Rainfall and run-off relation: Ann 20, iv, p 359.

Rating tables: Ann 18, iv, p 253; 19, iv, p 386; Bull 140, p 176; WS 28, p 130; 39, p 451; 66, p 173; 132, p 61.

Discharge measurements of Rio Grande near San Ildefonso, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	R. I. Meeker	130	709	5.82	5.45	4.126
June 9	do	132	484	6.0	4.45	2,905
June 30	do	132	434	5.72	4.25	2,481
July 28	do	115	171	3.77	2.15	644
July 29	do	115	162	3.16	2.0	512
September 21	do	80	102	2.25	1.62	230

Daily gage height, in feet, of Rio Grande near San Ildefonso, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.31	2.4	3.88	3.62	7.85	9.3	4.05	3.25	1.6	2.1	1.9	2.3
2	2.36	2.45	4.38	3.72	8.45	9.1	3.85	2.65	1.6	1.9	1.9	2.3
3	2.36	2.55	4.33	3.77	8.95	9.2	3.65	3.1	1.6	1.9	1.9	2.2
4	2.26	2.8	4.48	3.72	8.75	9.5	3.5	2.8	1.6	1.8	2.0	2.2
5	2.26	2.55	4.98	3.57	7.6	10.2	3.25	2.7	1.9	1.8	2.0	2.2
6	2.26	2.55	4.78	3.62	7.4	10.5	3.05	2.8	2.0	1.8	2.0	2.2
7	2.26	2.4	4.88	3.77	7.3	10.45	2.85	3.0	1.9	1.8	2.2	2.2
8	2.36	2.45	4.93	4.22	6.65	10.7	2.65	2.9	1.8	1.8	2.0	2.2
9	2.36	2.45	4.58	4.42	7.6	11.1	2.5	2.6	1.8	1.8	1.9	2.2
10	2.46	2.4	4.38	4.87	7.45	10.4	2.45	2.4	1.8	1.8	1.9	2.2
11	2.36	2.49	4.38	4.96	6.8	10.05	2.25	2.6	1.8	1.8	1.9	2.2
12	2.46	2.49	4.43	4.96	7.05	9.65	2.2	2.5	1.7	1.8	2.2	2.3
13	2.36	2.24	4.08	5.16	7.2	9.4	2.05	2.4	1.7	1.8	2.2	2.3
14	2.16	2.19	4.18	5.06	7.4	9.05	2.0	2.3	1.7	1.8	2.2	2.3
15	2.06	2.24	4.73	4.91	8.2	8.45	2.0	2.2	1.7	1.7	2.2	2.3
16	2.31	2.54	4.63	4.86	8.8	8.15	1.9	2.0	1.7	1.7	2.2	2.3
17	2.31	2.49	4.58	4.96	9.65	7.7	1.85	1.9	1.7	1.7	2.2	2.3
18	2.46	2.44	4.48	5.06	10.5	7.5	1.8	1.8	1.6	1.7	2.2	2.3
19	2.36	2.44	4.08	5.36	11.1	7.15	1.8	1.6	1.6	1.7	2.2	2.2
20	2.36	2.49	4.03	5.46	11.6	6.85	1.85	1.5	1.6	1.7	2.2	2.2
21	2.35	2.54	4.17	5.31	11.5	6.45	2.1	1.3	1.6	1.7	2.2	2.2
22	2.4	2.54	4.17	6.01	11.45	6.3	2.2	1.0	1.6	1.7	3.0	2.3
23	2.35	2.59	4.02	6.01	11.5	5.95	2.2	.6	1.6	1.9	3.0	2.3
24	2.35	2.79	3.92	6.31	11.75	5.7	2.1	.6	1.6	1.9	2.5	2.3
25	2.4	3.04	3.82	5.36	11.8	5.45	2.2	2.0	1.8	1.9	2.4	2.3
26	2.35	3.49	3.87	5.41	11.5	5.15	2.2	1.8	2.0	1.9	2.4	2.1
27	2.3	3.64	4.12	5.61	11.25	4.9	2.05	1.8	2.1	1.9	2.3	1.9
28	2.3	3.69	4.17	6.26	10.9	4.75	2.2	1.7	1.9	1.9	2.3	[illegible]
29	2.35	.....	3.77	6.81	10.6	4.45	2.1	1.6	1.8	1.9	2.4	1.9
30	2.4	.....	3.67	7.31	10.5	4.25	2.76	1.6	1.8	1.9	2.3	1.9
31	2.4	.....	3.57	.....	9.4	.....	3.45	1.6	.....	1.9	.....	1.9

Station rating table for Rio Grande near San Ildefonso, N. Mex., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	40	2.10	560	3.60	1,790	6.20	5,480
0.70	50	2.20	620	3.70	1,900	6.40	5,850
0.80	70	2.30	680	3.80	2,010	6.60	6,230
0.90	90	2.40	750	3.90	2,120	6.80	6,630
1.00	120	2.50	820	4.00	2,230	7.00	7,030
1.10	150	2.60	890	4.20	2,470	7.50	8,100
1.20	180	2.70	960	4.40	2,710	8.00	9,230
1.30	210	2.80	1,040	4.60	2,960	8.50	10,440
1.40	250	2.90	1,120	4.80	3,220	9.00	11,690
1.50	290	3.00	1,200	5.00	3,500	9.50	12,990
1.60	330	3.10	1,290	5.20	3,800	10.00	14,310
1.70	370	3.20	1,380	5.40	4,110	10.50	15,670
1.80	410	3.30	1,480	5.60	4,430	11.00	17,100
1.90	460	3.40	1,580	5.80	4,770	11.50	18,600
2.00	510	3.50	1,680	6.00	5,120		

The above table is based on six discharge measurements made during 1905 and three high-water measurements made in 1903. It is not well defined.

Estimated monthly discharge of Rio Grande near San Ildefonso, N. Mex., for 1905.

[Drainage area, 14,050 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	792	540	707	43,470	0.050	0.058
February	1,899	614	929	51,590	.066	.069
March	3,472	1,757	2,571	158,100	.183	.211
April	7,682	1,757	3,679	218,900	.262	.292
May	19,500	6,330	12,770	785,200	.909	1.05
June	17,400	2,530	9,625	572,700	.685	.764
July	2,290	410	874	53,740	.062	.072
August	1,430	40	629	38,680	.045	.052
September	560	330	389	23,150	.028	.031
October	560	370	422	25,950	.030	.035
November	1,200	460	638	37,960	.045	.050
December	680	460	617	37,940	.044	.051
The year	19,500	40	2,821	2,047,000	.201	2.74

RIO GRANDE NEAR SAN MARCIAL, N. MEX.

August 8, 1889, a station was established near San Marcial and a measurement was made which gave a discharge of 19 second-feet. Soon after this date, however, the river gage was destroyed and the locality was abandoned until January 29, 1895, when the station was reestablished by A. P. Davis at the bridge of the Atchison, Topeka and Santa Fe Railway, 1 mile south of San Marcial, N. Mex.

The channel is sandy and shifting. A number of bridge piers interfere with the current to a certain extent, but not with the observed gage heights. They sometimes affect the

discharge measurements. There is no overflow channel beyond the bridge. The section gives gravity flow.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the bridge abutment on the left bank of the stream.

The inclined gage established January 29, 1895, was carried away in 1896 and a wire gage was put in its place. This gage has since been abandoned, and the gage heights are now measured with a graduated rod from the deck of the bridge, but using the old gage datum. The top of the ties on the bridge is at elevation 19.00 feet on the gage. The range between high and low water is about 8 feet. Bench marks were established as follows: (1) The top of the capstone on which the bridge truss rests; elevation, 15.00 feet. (2) The top of the extension of the pier to which the old vertical gage was fastened; elevation, 13.00 feet. Elevations refer to the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The various hydrographers at this station have also acted as gage readers.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Cross section: Ann 18, iv, p 257.
Description: Ann 18, iv, pp 254-255; Bull 131, p 46; 140, p 177; WS 16, p 131; 28, p 120; 37, p 282; 50, pp 351-352; 66, p 68; 84, pp 183-184; 99, pp 382-383; 132, pp 62-63.
Discharge: Ann 11, ii, p 107; 18, iv, p 256; Bull 131, p 46; 140, p 177; WS 16, p 131; 28, p 129; 37, p 283; 50, p 352; 66, pp 68-69; 84, pp 184-185; 99, pp 383-385; 132, pp 63-64, 127.
Discharge, mean daily: WS 132, p 66.
Discharge, monthly: Ann 18, iv, p 257; 19, iv, p 388; 20, iv, pp 358, 371; 21, iv, p 261; 22, iv, 352; WS 75, p 155; 84, p 186; 99, p 386; 132, p 67.
Discharge, yearly: Ann 20, iv, p 58.
Gage heights: Bull 140, p 178; WS 11, p 66; 16, p 131; 28, p 128; 37, p 283; 50, p 352; 66, p 69; 84, p 185; 99, p 386; 132, p 65.
Hydrographs: Ann 19, iv, p 389; 20, iv, p 371; 21, iv, p 261; 22, iv, p 352.
Rainfall and run-off relation: Ann 20, iv, p 359.
Rating tables: Ann 18, iv, p 256; 19, iv, p 387-388; WS 28, p 131.

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	L. W. Broyles	250	2.04	7.8	[illegible]
January 6	do	325	2.10	8.0	[illegible]
January 9	do	238	2.39	7.9	[illegible]
January 12	do	297	3.10	8.1	[illegible]
January 15	do	203	3.38	8.0	[illegible]
January 18	do	184	2.95	7.9	[illegible]
January 21	do	193	3.37	8.0	651
January 24	do	176	3.05	7.9	[illegible]
January 27	do	211	2.80	7.9	[illegible]
January 31	do	197	3.43	8.0	[illegible]
February 3	do	237	3.50	7.9	[illegible]
February 6[a]	do	184	3.59	7.9	[illegible]
February 9	do	309	3.30	8.1	1,019
February 12	do	258	2.98	8.0	[illegible]
February 15	do	237	2.83	8.1	671
February 18	do	284	2.93	8.0	831
February 21	do	243	3.28	8.1	[illegible]
February 24	do	246	3.01	8.0	[illegible]
February 28	do	660	3.47	8.5	2,[illegible]
March 3	do	720	4.01	8.6	2,886

[a] Ice in river.

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
March 5	L. W. Broyles	929	5.46	9.0	5,073
March 8	do	979	4.70	8.9	4,598
March 10	do	697	6.88	9.2	4,795
March 12	do	664	5.04	8.6	3,344
March 15	do	554	5.64	8.4	3,125
March 18	do	833	4.57	9.3	3,806
March 21	do	717	3.79	8.8	2,721
March 24	do	731	4.07	9.0	2,972
March 27	do	630	3.49	8.6	2,198
March 31	do	652	4.18	8.7	2,724
April 3	do	852	3.91	9.2	3,331
April 6	do	589	3.07	8.5	1,808
April 9	do	584	3.34	8.7	1,950
April 12	do	972	4.02	9.6	3,911
April 15	do	1,026	3.90	9.6	4,006
April 18	do	954	4.03	9.1	3,840
April 21	do	997	4.30	9.4	4,288
April 24	do	1,769	5.50	10.2	9,726
April 30	do	1,571	4.68	10.2	7,356
May 3	do	1,558	5.03	10.7	7,829
May 5	do	2,318	5.03	11.4	11,650
May 7	do	1,833	5.98	10.7	10,955
May 9	do	1,868	5.92	10.0	11,058
May 11	do	1,597	5.44	10.3	8,694
May 13	do	1,656	6.37	10.2	10,543
May 15	do	1,684	6.15	10.3	10,361
May 17	do	2,063	6.18	10.9	12,758
May 19	do	2,474	6.51	11.6	16,097
May 21	do	2,621	6.72	12.5	17,607
May 23	do	4,093	6.55	12.8	26 810
May 25	do	4,294	5.62	12.7	24,142
May 28	do	4,642	5.51	13.2	25,577
May 31	do	2,847	7.12	13.1	20,264
June 3	do	3,154	6.33	11.9	19,973
June 6	do	3,298	5.09	11.6	16,780
June 9	do	2,821	5.34	12.7	15,071
June 12	do	3,341	5.74	12.5	19,162
June 15	do	2,660	4.40	10.9	11,702
June 18	do	2,744	5.00	9.7	13,726
June 21	do	1,976	4.55	9.4	9,000
June 24	do	1,340	4.74	8.7	6,345
June 26	do	983	4.34	8.4	4,271
June 28	do	882	3.97	8.2	3,505
June 30	do	722	3.66	8.0	2,641
July 3	do	527	3.03	7.6	1,598
July 6	do	358	3.18	7.4	1,143
July 9	do	385	2.04	7.2	784
July 12	do	209	2.23	6.8	466
July 15	do	176	1.56	6.6	274
July 18	do	141	1.33	6.4	188
July 21	do	117	1.51	6.2	177
July 24	do	108	1.46	6.3	158
July 27	do	97	0.84	6.3	81
July 31	do	35	1.91	5.9	67

Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
August 3	L. W. Broyles	334	2.56	7.4	854
August 6	do	339	1.78	7.1	602
August 9	do	334	1.91	7.3	637
August 12	do	298	2.29	6.9	681
August 15	do	207	2.15	6.5	446
August 18	do	131	1.10	6.3	146
August 21	do	80	1.20	6.0	94
August 24	do	13	0.46	5.6	6
September 7	do	117	2.74	7.3	321
September 9	do	79	1.90	6.7	150
September 11	do	61	1.52	6.5	93
September 25	do	47	1.11	5.6	52
September 27	do	144	1.60	6.7	231
September 29	do	90	1.81	6.3	163
October 5	D. H. West	92	1.71	5.9	157
October 6	do	97	1.56	5.9	151
October 8	do	74	1.69	5.8	125
October 11	do	63	1.32	5.6	83
October 14	do	70	1.39	5.7	97
October 17	do	65	1.23	5.7	80
October 20	do	68	1.24	5.7	84
October 23	do	73	1.30	5.8	95
October 26	do	84	1.50	5.9	126
October 28	do	88	1.67	5.9	147
October 31	do	101	1.71	6.2	173
November 3	do	94	1.86	6.2	175
November 9	do	255	2.90	7.1	740
November 11	do	204	3.27	7.05	667
November 14	do	232	2.51	7.0	582
November 17	do	210	2.28	6.8	479
November 20	do	196	2.45	6.8	481
November 23	do	241	2.52	7.0	607
November 25	do	548	2.96	7.6	1,624
November 28	do	201	2.68	6.9	539
November 30	do	446	3.42	7.7	1,527
December 3	Geo. W. King	317	2.57	7.3	815
December 6	do	249	2.14	7.2	533
December 9	do	228	2.60	7.2	593
December 12	do	220	2.74	7.2	603
December 15	do	347	2.22	7.5	770
December 18	do	275	2.26	7.3	621
December 21	do	315	2.05	7.4	647
December 24	do	127	1.81	6.9	230
December 27	do	93	1.90	6.5	177
December 30	do	105	1.77	6.5	186

Daily gage height, in feet, of Rio Grande near San Marcial, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.7	8.0	8.8	8.85	10.35	12.6	8.05	6.75	.....	6.4	6.1	7.7
2	7.7	7.9	8.75	8.9	10.5	12.2	7.75	6.9	.....	6.15	6.1	7.4
3	7.8	7.9	8.65	9.1	10.65	11.95	7.6	7.15	.....	6.1	6.2	7.3
4	7.95	8.0	9.1	8.85	11.25	11.5	7.5	7.15	.....	6.0	6.35	7.2
5	8.0	8.0	9.05	8.65	11.5	11.45	7.45	7.0	.....	5.95	6.45	7.2
6	7.95	8.05	8.95	8.5	11.45	11.55	7.4	7.15	6.8	5.95	6.5	7.15
7	7.8	8.65	8.9	8.4	10.7	11.9	7.35	7.0	7.3	5.9	6.65	7.25
8	7.9	8.45	8.95	8.5	10.15	12.3	7.3	7.05	6.7	5.8	6.9	7.25
9	7.9	8.15	9.25	8.75	9.9	12.7	7.2	7.4	6.7	5.7	7.05	7.15
10	8.05	7.95	9.25	9.05	10.1	12.55	7.05	7.2	6.85	5.6	6.75	7.3
11	8.15	7.9	8.85	9.45	10.3	12.5	6.9	7.0	6.5	5.6	7.05	7.3
12	8.1	8.0	8.6	9.65	10.45	12.35	6.8	6.95	6.1	5.7	7.0	7.2
13	8.1	7.8	8.8	9.95	10.1	11.9	6.8	6.8	5.4	5.7	6.9	7.3
14	8.05	7.65	8.75	9.65	10.3	11.3	6.7	6.75	5.3	5.7	6.95	7.3
15	8.0	8.0	8.6	9.55	10.25	11.0	6.6	6.55	.....	5.75	6.9	7.45
16	8.0	7.9	8.65	9.7	10.65	10.4	6.6	6.45	.....	5.7	6.8	7.5
17	8.05	8.0	8.95	9.2	10.85	10.05	6.5	6.4	.....	5.7	6.8	7.4
18	7.9	8.0	9.2	9.1	11.1	9.7	6.4	6.3	.....	5.7	6.8	7.3
19	7.9	8.1	9.15	9.15	11.45	9.3	6.3	6.2	.....	5.7	6.8	7.4
20	7.8	8.25	9.15	9.3	11.85	9.4	6.2	6.1	.....	5.7	6.8	7.4
21	8.0	8.15	8.8	9.4	12.35	9.35	6.2	6.0	.....	5.7	6.8	7.4
22	8.0	8.05	8.7	9.5	12.75	9.0	6.1	5.85	.....	5.8	6.9	7.25
23	7.95	7.95	8.75	9.7	12.95	8.8	6.2	5.7	.....	5.8	7.0	7.2
24	7.9	8.0	9.0	10.3	13.05	8.7	6.35	5.6	.....	5.75	8.65	6.9
25	7.9	8.8	8.9	11.0	12.65	8.55	6.2	.....	5.6	5.8	7.75	6.5
26	7.9	8.6	8.75	10.45	13.15	8.35	6.4	.....	7.55	5.9	7.6	6.4
27	7.9	8.45	8.6	10.15	13.2	8.2	6.25	.....	7.3	5.9	7.3	6.5
28	7.9	8.55	8.6	9.95	13.2	8.2	6.1	.....	6.2	5.95	6.95	6.5
29	7.95	.....	8.7	10.0	13.15	8.1	6.1	.....	6.7	6.05	6.95	6.5
30	8.0	.....	8.8	10.2	13.0	8.0	6.0	.....	6.55	6.05	7.7	6.5
31	8.0	.....	8.7	.....	13.0	.....	5.9	.....	.....	6.15	.....	6.5

NOTE.—No flow August 25 to September 5 and September 15–24

Daily discharge in second-feet of Rio Grande near San Marcial, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	370	730	4,090	2,910	7,500	19,360	2,770	405	0	180	160	1,530
2	400	780	3,790	2,970	7,630	19,660	1,990	495	0	170	160	990
3	[a] 530	[a] 830	[a] 3,190	[a] 3,210	[a] 7,790	[a] 19,970	[a] 1,600	[a] 645	0	165	[a] 175	[a] 815
4	650	930	5,620	2,560	10,830	17,110	1,375	645	0	160	220	680
5	685	930	[a] 5,350	2,120	[a] 12,200	16,350	1,260	570	0	[a] 160	260	610
6	[a] 625	[a] 970	4,840	[a] 1,810	12,120	[a] 16,480	[a] 1,145	[a] 645	180	[a] 155	285	[a] 505
7	470	2,760	4,600	1,730	[a] 10,950	15,810	1,045	570	[a] 320	150	375	585
8	570	2,130	[a] 4,630	1,810	10,010	15,440	965	580	150	[a] 125	550	605
9	[a] 570	[a] 1,180	4,830	[a] 2,050	[a] 10,560	[a] 15,070	[a] 785	[a] 700	[a] 150	105	[a] 690	[a] 565
10	820	720	[a] 4,920	2,720	9,630	15,930	665	670	195	85	450	655
11	1,005	670	3,950	3,600	[a] 8,690	17,390	545	645	[a] 95	[a] 85	[a] 665	655
12	[a] 920	[a] 770	[a] 3,340	[a] 4,030	10,620	[a] 18,460	[a] 465	[a] 710	50	95	580	[a] 605
13	920	500	3,560	4,690	[a] 10,040	16,370	465	620	10	95	510	660
14	800	290	3,500	4,090	10,700	13,570	370	590	5	[a] 95	[a] 550	660
15	[a] 690	[a] 570	[a] 3,340	[a] 3,900	[a] 10,160	[a] 12,170	[a] 275	[a] 470	0	95	530	[a] 740
16	690	560	3,370	4,200	11,760	11,880	275	350	0	85	480	770
17	760	740	3,540	3,900	[a] 12,560	12,800	230	255	0	[a] 80	[a] 480	695
18	[a] 545	[a] 830	[a] 3,600	[a] 3,840	13,710	[a] 13,730	[a] 190	[a] 145	0	80	480	[a] 620
19	545	880	3,490	3,910	[a] 15,380	10,950	185	125	0	85	480	645
20	440	980	3,490	4,140	16,550	10,170	180	110	0	[a] 85	[a] 480	645
21	[a] 650	[a] 840	[a] 2,720	[a] 4,290	[a] 17,350	[a] 8,810	[a] 175	[a] 95	0	85	480	[a] 645
22	650	770	2,600	4,840	23,400	7,480	170	60	0	[a] 95	540	515
23	590	710	2,660	5,950	[a] 28,600	6,720	165	25	0	95	[a] 605	445
24	[a] 535	[a] 740	[a] 2,970	[a] 10,280	29,070	[a] 6,340	[a] 160	[a] 5	0	90	3,720	[a] 230
25	550	3,220	2,780	14,160	[a] 23,540	5,300	120	0	[a] 50	105	[a] 1,920	175
26	570	2,600	2,490	9,210	28,000	[a] 4,080	120	0	470	[a] 125	1,620	160
27	[a] 590	2,130	[a] 2,200	7,210	27,100	3,500	[a] 80	0	[a] 400	135	1,160	[a] 175
28	590	[a] 2,440	2,280	6,610	[a] 25,580	[a] 3,500	70	0	145	[a] 150	[a] 620	180
29	630	.....	2,560	6,760	23,600	3,070	70	0	[a] 230	160	620	185
30	675	.....	2,840	[a] 7,360	20,430	[a] 2,640	65	0	210	160	[a] 1,530	[a] 185
31	[a] 675	.....	[a] 2,720	.....	[a] 19,060	.....	[a] 65	0	.....	[a] 170	.....	185

[1] Meter measurements.

Estimated monthly discharge of Rio Grande near San Marcial, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,005	370	636	39,114
February	3,220	290	1,150	63,968
March	5,620	2,200	3,544	217,904
April	14,160	1,730	4,695	279,392
May	29,070	7,500	15,649	962,221
June	19,970	2,640	12,004	714,268
July	2,770	65	582	35,782
August	710	0	327	20,043
September	470	0	89	5,276
October	180	80	120	7,349
November	3,720	160	713	42,397
December	1,530	160	559	34,344
The year	29,070	0	3,339	2,422,008

RIO GRANDE NEAR EL PASO, TEX.

This station was located at the pumping house of the smelter company, 3 miles north of El Paso, Tex. The bed of the stream here is composed of mud, constantly shifting and changing. May 1, 1897, the station was placed under the charge of W. W. Follett, consulting engineer, International (Water) Boundary Commission, and by him removed 1 mile farther up the river to Courchesne's limekiln.

The left bank of the river is formed by the loose rock fill of the Atchison, Topeka and Santa Fe Railway embankment and will not overflow. The right bank is not so good, being made ground and subject to overflow. The bottom of the river here has also proved unstable, scouring on a rise and filling on a fall of the river. During the spring flood of 1905 the right bank began to erode and receded about 60 or 80 feet. This has left a bad low-water section. There is a large shifting bar about mid stream. It is still the best site for a station in the vicinity of El Paso, however, as the entire bed is constantly shifting for many miles above and below. On account of the shifting bed the only accurate method of estimating the daily discharge is by taking a large number of measurements. In extreme high water the bottom overflows slightly for a width of 200 feet beyond the right cable support.

Discharge measurements are made by means of a cable of 410 feet span, car, tagged wire, and guy wire. The initial point for soundings is the cable support on the left bank.

River heights were measured at the masonry pump-foundation pier. The pier was torn down in October, 1902, so an inclined wooden gage was established some 60 feet upstream. This is a timber bolted to steel bars set with cement in holes drilled in solid rock. The range between high and low water is about 11 feet. The bench mark is a one-half inch iron bolt set in solid rock at the head of the gage; elevation, 13.00 feet above the datum of the gage.

The observations at this station during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is W. L. Follett and the gage reader is Valmore Courchesne.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Cross section: Ann 18, iv, p 258.

Description: Ann 14, iv, p 114; 18, iv, pp 257-259; Bull 131, p 46; 140, p 178; WS 16, p 132; 28, p 120; 37, pp 283-284; 50, p 352; 66, p 70; 84, p 181; 99, pp 378-379; 132, pp 67-68.

Discharge: Ann 18, iv, p 259; Bull 140, p 179; WS 16, pp 132-133; 28, p 120; 37, p 284; 50, p 353; 66, p 70; 84, pp 181-182; 99, pp 379-381; 132, pp 68-69.

Discharge, mean daily: WS 132, p 70.

Discharge, monthly: Ann 11, ii, p 99; 12, ii, pp 350, 360; 13, iii, p 94; 14, iv, pp 114-115; 19, iv, p 390; 20 iv, pp 358, 372; 21, iv, p 262; 22, iv, p 353; WS 75, p 155; 84, p 183; 99, p 382; 132, p 71.

Discharge, yearly: Ann 11, ii, p 54; 13, iii, p 99; 20, iv, p 58.

Gage heights: Bull 131, p 47; 140, p 179; WS 11, p 67; 16, p 133; 28, p 128; 37, p 284; 50, p 353; 66, p 70; 84, p 182; 99, pp 381-382; 132, p 69.

Hydrographs: Ann 12, ii, p 280; 14, ii, p 114; 19, iv, p 390; 21, iv, p 263; 22, iv, p 353; WS 75, p 156.

Rating tables: Ann 19, iv, p 389; Bull 131, p 47.

Sediment observations: Ann 11, ii, p 57.

Discharge measurements of Rio Grande near El Paso, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	Valmore Courchesne	224	1.64	6.4	367
January 8	do	228	1.68	6.3	384
January 11	do	316	2.42	7.2	765
January 14	do	395	2.57	7.6	1,014
January 18	do	314	2.45	7.2	769
January 21	do	267	2.34	7.0	625
January 24	do	225	2.05	6.4	461
January 28	do	226	2.38	6.7	538
January 31	do	210	2.18	6.5	458
February 3	do	222	2.20	6.6	488
February 7	do	223	2.20	6.6	490
February 10	do	268	2.49	7.0	668
February 12	do	404	2.52	7.6	1,017
February 15	do	274	2.14	6.8	587
February 19	do	293	2.46	7.2	721
February 21	do	464	2.71	8.0	1,258
February 25	do	360	2.45	7.4	881
February 28	do	438	3.11	8.15	1,364
March 3	do	588	4.36	9.2	2,562
March 8	do	861	4.21	9.9	3,625
March 12	do	1,126	4.36	10.8	4,911
March 15	do	670	5.14	9.8	3,445
March 18	do	582	4.78	9.8	2,782
March 21	do	801	3.96	10.3	3,170
March 24	do	690	3.34	9.7	2,307
March 31	do	629	2.69	9.3	1,694
April 3	do	808	2.55	9.9	2,060
April 6	do	737	3.01	9.9	2,222
April 9	do	516	2.76	8.9	1,423
April 14	do	798	3.67	10.35	2,932
April 17	do	804	4.23	10.6	3,397
April 20	do	757	3.92	10.3	2,971
April 24	do	820	4.39	10.9	3,596
April 29	do	1,295	5.42	12.75	7,014
May 2	do	912	5.67	11.4	5,170
May 6	do	1,253	5.18	12.5	6,490
May 9	do	1,633	5.97	13.5	9,755
May 12	do	1,063	5.50	11.5	5,847
May 16	do	1,385	4.40	12.0	6,098
May 20	do	1,201	5.05	12.3	6,065
May 23	do	1,715	5.67	13.9	9,717
May 25	do	1,870	5.27	14.6	9,859
May 28[a]	do	3,722	4.51	15.6	16,795
May 30[a]	do	4,094	4.62	15.9	18,924
June 2[a]	do	3,806	5.44	16.1	20,722
June 6	do	2,930	5.46	14.35	15,993
June 9	do	2,738	6.43	14.8	17,609
June 12	do	3,549	6.67	14.9	23,683
June 15	do	3,607	6.54	14.9	23,591
June 18	do	2,517	6.73	13.85	16,935
June 21	do	1,162	6.29	12.4	7,312
June 25	do	1,151	4.97	11.1	5,724
June 27	do	1,080	4.23	10.5	4,565

[a] Includes overflow sections.

Discharge measurements of Rio Grande near El Paso, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
June 30	Valmore Courchesne	1,031	3.30	9.5	3,398
July 3	do	937	2.55	8.9	2,388
July 7	do	669	2.07	8.1	1,383
July 10	do	502	2.04	7.6	1,024
July 13	do	363	1.91	7.4	694
July 16	do	299	1.58	7.1	471
July 19	do	239	1.74	6.8	415
July 22	do	216	1.79	6.7	386
July 25	do	263	1.65	6.8	435
July 28	do	223	1.84	6.8	410
July 31	do	174	1.50	6.5	261
August 3	do	149	1.33	6.3	198
August 7	do	369	1.97	7.3	726
August 10	do	307	1.86	7.0	572
August 12	W. L. Follett	481	2.04	7.7	979
August 15	W. W. Follett	270	1.81	6.8	488
August 18	do	197	1.52	6.4	300
August 21	do	156	1.28	6.2	199
August 24	do	123	1.19	6.0	146
August 27	do	97	1.02	5.8	99
August 30	W. L. Follett	75	0.75	5.6	56
September 2	do	52	0.67	5.4	35
September 5	do	34	0.91	5.4	31
September 8	do	35	0.91	5.4	32
September 11	do	33	0.82	5.3	27
September 12	do	113	1.24	6.2	140
September 14	do	88	1.27	5.9	112
September 17	do	68	1.13	5.7	77
September 20	do	32	1.47	5.5	47
September 23	do	20	0.95	5.25	19
September 26	do	16	1.00	5.2	16
September 29	do	92	1.66	6.2	153
October 2	do	113	1.76	6.45	199
October 5	do	85	1.53	6.0	130
October 8	do	72	1.25	5.8	90
October 11	do	45	1.31	5.6	59
October 14	do	38	1.16	5.5	44
October 17	do	28	0.86	5.4	24
October 20	do	23	1.00	5.3	23
October 23	do	27	1.15	5.35	31
October 26	do	30	1.30	5.4	39
October 29	do	34	1.15	5.4	39
November 1	do	35	1.03	5.5	36
November 4	do	58	1.26	5.65	73
November 7	do	83	1.37	5.85	114
November 10	do	148	1.36	6.2	202
November 15	do	216	1.83	6.75	395
November 18	do	217	1.58	6.7	342
November 21	do	208	1.49	6.6	309
November 24	do	222	1.51	6.6	335
November 27	do	569	2.51	8.05	1,426
November 30	do	772	2.06	8.35	1,588
December 3	do	659	2.05	8.2	1,349

Discharge measurements of Rio Grande near El Paso, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
December 6	W. L. Follett	426	1.62	7.25	691
December 9	do	374	1.45	6.9	541
December 12	do	375	1.59	7.0	595
December 15	do	352	1.63	7.0	572
December 18	do	335	1.73	7.0	581
December 21	do	334	1.65	6.95	550
December 24	do	304	1.49	6.9	454
December 27	do	300	1.62	6.9	486
December 30	do	201	1.38	6.3	278

Daily gage height, in feet, of Rio Grande near El Paso, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.4	6.5	9.05	9.6	11.55	16.05	9.35	6.5	5.45	6.65	5.5	7.75
2	6.4	6.55	9.2	9.9	11.4	16.1	9.15	6.4	5.4	6.4	5.6	7.65
3	6.4	6.55	9.15	9.85	11.6	15.95	8.9	6.35	5.4	6.25	5.6	8.2
4	6.3	6.5	9.4	9.65	11.7	15.4	8.7	6.3	5.4	6.1	5.65	7.9
5	6.25	6.5	9.7	9.7	12.15	14.95	8.6	6.3	5.4	6.0	5.7	7.55
6	6.25	6.5	9.6	9.9	12.45	14.25	8.45	6.4	5.4	6.0	5.7	7.25
7	6.3	6.6	9.95	9.6	12.9	13.85	8.2	7.3	5.4	5.9	5.85	7.1
8	6.3	6.6	9.95	9.25	13.3	13.85	8.05	7.15	5.4	5.8	6.0	7.0
9	6.3	6.7	10.1	8.9	13.5	14.75	7.85	6.95	5.4	5.8	6.05	6.9
10	6.85	7.25	10.8	8.85	12.9	14.5	7.65	7.05	5.3	5.65	6.2	6.8
11	7.2	8.05	10.8	9.0	11.75	14.5	7.6	7.0	5.3	5.6	6.3	6.85
12	7.2	7.65	10.8	9.2	11.5	14.9	7.6	7.65	5.9	5.6	6.35	7.0
13	8.05	7.3	10.4	9.75	11.65	14.75	7.45	7.4	5.95	5.55	6.65	7.05
14	7.7	7.0	10.05	10.35	12.05	14.9	7.3	6.95	5.9	5.5	6.7	7.05
15	7.5	6.8	9.9	10.8	12.2	14.85	7.2	6.8	5.9	5.45	6.7	7.0
16	7.4	6.8	9.9	10.85	12.05	14.85	7.1	6.65	5.8	5.4	6.7	7.0
17	7.3	6.7	9.9	10.6	11.9	14.35	7.0	6.5	5.7	5.4	6.7	7.1
18	7.2	6.45	9.7	10.6	12.05	13.9	6.9	6.4	5.6	5.4	6.7	7.0
19	7.0	7.2	9.7	10.55	12.2	13.35	6.8	6.3	5.55	5.4	6.6	7.15
20	7.0	8.05	10.1	10.35	12.35	12.8	6.75	6.2	5.5	5.3	6.6	7.05
21	6.95	7.95	10.3	10.3	12.7	12.4	6.7	6.2	5.4	5.3	6.6	7.0
22	6.7	7.6	10.3	10.3	13.3	12.0	6.7	6.05	5.35	5.3	6.55	6.95
23	6.6	7.75	10.05	10.7	13.9	11.85	6.9	6.0	5.25	5.3	6.55	6.85
24	6.4	7.65	9.75	11.0	14.3	11.4	6.95	6.0	5.2	5.4	6.6	6.9
25	6.4	7.45	9.55	11.35	14.65	11.1	6.8	5.95	5.2	5.4	6.8	6.95
26	6.55	7.5	9.55	12.15	15.0	10.7	6.65	5.8	5.2	5.4	6.9	6.9
27	6.75	7.65	9.75	13.0	15.3	10.5	6.6	5.8	5.2	5.4	7.8	6.8
28	6.7	8.05	9.6	13.1	15.55	10.15	6.7	5.75	5.8	5.4	8.25	6.55
29	6.6	.....	9.45	12.9	15.75	9.9	6.8	5.6	6.25	5.4	8.75	6.3
30	6.5	.....	9.3	12.15	15.9	9.6	6.55	5.55	6.05	5.45	8.3	6.3
31	6.5	.....	9.3	.....	15.9	.....	6.5	5.5	.....	5.5	.....	6.2

Daily discharge, in second-feet, of Rio Grande near El Paso, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	405	460	2,390	1,880	5,380	20,270	3,150	260	40	230	[a] 35	1,035
2	385	475	2,560	2,060	[a] 5,170	[a] 20,720	2,810	230	[a] 35	[a] 195	60	965
3	[a] 365	[a] 475	[a] 2,500	[a] 2,030	5,410	20,320	[a] 2,390	[a] 215	35	170	60	[a] 1,350
4	340	460	2,860	1,960	5,530	18,840	2,130	200	30	145	[a] 75	1,140
5	330	460	3,320	2,040	6,070	17,620	2,000	200	[a] 30	[a] 130	85	895
6	340	460	3,170	[a] 2,220	[a] 6,430	[a] 15,630	1,820	250	30	130	85	[a] 690
7	370	[a] 490	3,700	1,980	7,800	14,190	[a] 1,510	[a] 725	30	110	[a] 115	625
8	[a] 385	490	[a] 3,700	1,700	9,100	14,190	1,350	645	[a] 35	[a] 90	150	585
9	385	550	3,910	[a] 1,420	[a] 9,760	[a] 17,410	1,200	545	30	90	165	[a] 540
10	620	[a] 820	4,910	1,370	8,590	18,300	[a] 1,060	[a] 595	30	65	[a] 200	500
11	[a] 765	1,290	4,910	1,530	6,350	20,190	970	570	[a] 25	[a] 60	235	525
12	765	[a] 1,050	[a] 4,910	1,740	[a] 5,850	[a] 23,680	910	[a] 950	[a] 110	60	255	[a] 595
13	1,290	860	4,330	2,310	5,960	23,050	[a] 735	810	115	50	360	620
14	[a] 1,075	695	3,810	[a] 2,930	6,570	23,620	620	565	[a] 110	[a] 45	380	620
15	950	[a] 585	[a] 3,590	3,760	6,680	[a] 23,270	545	[a] 490	110	35	[a] 380	[a] 570
16	890	585	3,370	3,850	[a] 6,200	23,270	[a] 470	415	90	25	370	575
17	830	550	3,150	[a] 3,400	5,740	20,100	450	345	[a] 75	[a] 25	355	630
18	[a] 770	460	[a] 2,700	3,400	5,880	[a] 17,250	430	[a] 300	60	25	[a] 340	[a] 580
19	630	[a] 720	2,700	3,330	6,020	13,620	[a] 415	250	50	25	310	655
20	625	1,290	3,020	[a] 3,040	[a] 6,180	9,970	400	200	[a] 45	[a] 25	310	605
21	[a] 605	[a] 1,220	[a] 3,170	2,970	6,980	[a] 7,310	385	[a] 200	35	25	[a] 310	[a] 580
22	540	1,000	3,170	2,970	8,360	6,820	[a] 385	160	30	25	305	530
23	515	1,100	2,810	3,380	[a] 9,720	6,640	485	145	[a] 20	[a] 30	315	455
24	[a] 460	1,035	[a] 2,380	[a] 3,780	9,800	6,090	510	[a] 145	15	40	[a] 335	[a] 455
25	460	[a] 910	2,080	4,430	[a] 10,210	[a] 5,720	[a] 435	130	15	40	485	480
26	500	975	2,080	5,900	12,640	4,950	385	100	[a] 15	[a] 40	560	475
27	555	1,070	2,380	7,500	14,720	[a] 4,560	360	[a] 100	15	40	[a] 1,240	[a] 450
28	[a] 540	[a] 1,300	2,150	7,700	[a] 16,450	4,150	[a] 380	85	110	40	1,530	365
29	500	.....	1,920	[a] 7,300	17,860	3,860	410	55	[a] 165	[a] 40	1,870	280
30	460	.....	1,690	5,900	18,920	[a] 3,510	285	[a] 50	140	40	[a] 1,560	[a] 280
31	[a] 460	.....	[a] 1,690	.....	[a] 18,920	.....	[a] 260	45	.....	40	.....	245

[a] Meter measurements.

Estimated monthly discharge of Rio Grande near El Paso, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,290	330	584	35,920
February	1,300	460	780	43,309
March	4,910	1,690	3,065	188,489
April	7,700	1,370	3,326	197,911
May	18,920	5,170	8,879	545,950
June	23,680	3,510	14,304	851,147
July	3,150	260	956	58,800
August	950	45	322	19,785
September	165	15	56	3,322
October	230	25	69	4,225
November	1,870	35	428	25,458
December	1,350	245	610	37,478
The year	23,680	15	2,782	2,011,794

RIO GRANDE ABOVE PRESIDIO, TEX.

This station was established April 4, 1900, by the International (Water) Boundary Commission. It was 9 miles above Presidio and above the mouth of Rio Conchos, one of the principal tributaries of the Rio Grande, and about 200 miles below El Paso. The station was in a straight stretch of the river, but in the bight of a long bend. In 1903 the river began to erode a cut-off across this bend and the spring flood of 1905 deepened this channel to such an extent that more water passed through it than through the station, and it became necessary to abandon its location. In September, 1905, the station was moved 8 miles farther upstream and rebuilt. Its location is far enough above the mouth of Rio Conchos to be free from the effects of backwater from that stream.

The river is nearly straight for one-fourth mile above and below the new location. Both banks overflow slightly in extreme flood, but no large amount of water passes outside the measured section. The bed is shifting sand. The banks are fairly solid, but would erode if a heavy current should strike them.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire. The initial point for soundings is the cable support on the left bank.

The gage is an inclined scantling fastened to posts sunk in the ground. The bottom of the river was gage height 1.5 feet September 21, 1905, and marks showed high water to be 9.5 feet. The bench mark is the top of a mesquite post level with the ground back of the left guy-cable deadman; elevation, 9.35 feet above the datum of the gage.

The observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer was Jas. P. Hague, and the gage reader was Preciliano Spencer.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, p 355; 66, p 72; 84, p 177; 99, p 373; 132, p 71.
Discharge: WS 50, p 355; 66, pp 72-73; 84, p 178; 99, pp 373-375; 132, p 72.
Discharge, mean daily: WS 132, p 74.
Discharge, monthly: Ann 22, iv, p 354; WS 75, p 157; 84, p 179; 99, p 376; 132, p 75.
Gage heights: WS 50, p 355; 66, p 73; 84, p 178; 99, pp 375-376; 132, p 73.

Discharge measurements of Rio Grande above Presidio, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	Jas. P. Hague	158	2.04	3.55	323
January 6	do	145	2.03	3.4	295
January 9	do	143	1.96	3.4	280
January 12	do	140	1.91	3.3	267
January 15	do	167	2.07	3.6	346
January 18	do	213	2.98	4.2	634
January 21	do	205	2.70	3.95	554
January 24	do	186	2.52	3.8	469
January 27	do	171	2.29	3.7	392
January 30	do	163	2.28	3.55	371
February 2	do	169	2.09	3.55	354
February 5	do	171	2.35	3.7	401
February 8	do	155	2.06	3.5	320
February 11	do	159	2.13	3.5+	337
February 14	do	163	2.12	3.55	349
February 17	do	200	2.71	3.9	541
February 20	do	161	2.37	3.6	381
June 17[a]	do	1,489	4.10	8.8	6,109
June 21[a]	do	1,353	3.61	8.6	4,888

[a] Channel only. Bottoms overflowed. The channel was carrying less than 50 per cent of the total discharge at the station. The actual discharge was computed from daily gage heights, the flow of lower Presido station, and of Conchos River.

Discharge measurements of Rio Grande above Presidio, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
June 24[a]	Jas. P. Hague	1,322	3.34	8.5	4,411
June 27[a]	do	1,301	3.33	8.5	4,331
July 1[a]	do	1,269	2.97	8.2	3,771
July 5[a]	do	1,097	2.43	7.0	2,668
July 8[a]	do	917	1.93	6.2	1,774
July 11	do	671	2.13	5.0	1,432
July 14	do	422	2.91	4.2	1,226
July 17	do	526	3.48	5.6	1,830
July 19[b]	do	633	3.61	6.05	2,285
July 21	do	507	3.58	5.5	1,814
July 24	do	456	3.37	5.2	1,537
July 27	do	295	3.16	3.65	932
July 30	do	290	3.14	3.6	912
August 2	do	338	2.67	3.7	903
August 5	do	333	2.79	3.7	929
August 8	do	232	2.02	2.6	469
August 10	do	235	2.36	2.7	555
August 13	do	223	1.87	2.6	416
August 16	do	259	2.12	3.0	549
August 19	do	265	2.13	3.0	565
August 22	do	260	2.03	2.8	528
August 25	do	225	1.89	2.4	426
August 27	do	201	1.61	2.15	323
August 30	do	213	1.59	2.2	339
September 2	do	127	1.57	1.8	200
September 5	do	171	1.77	2.3	302
September 7	do	419	4.09	5.4	1,712
September 10	do	282	2.20	3.15	620
September 13	do	277	2.13	3.0	590
September 16	do	70	1.51	1.5	106
September 18	do	80	1.69	1.5	135
September 21	do	71	1.56	1.5	111
September 26[c]	do	75	1.57	3.0	118
September 29	do	65	1.66	2.9	108
October 2	do	63	1.52	2.75	96
October 5	do	54	1.44	2.7	78
October 8	do	63	1.41	2.7	89
October 11	do	66	1.39	2.7	92
October 14	do	53	1.38	2.7	73
October 17	do	56	1.30	2.7	73
October 20	do	62	1.29	2.7	80
October 23	do	58	1.31	2.7	76
October 29	do	45	1.16	2.6	52
November 1	do	46	1.11	2.6	51
November 5	do	33	1.09	2.5	36
November 8	do	48	1.23	2.65	59
November 11	do	136	1.66	3.4	226
November 14	do	164	1.59	3.5	260

[a] Channel only. Bottoms overflowed. The channel was carrying less than 50 per cent of the total discharge at the station. The actual discharge was computed from daily gage heights, the flow of lower Presidio station, and of Conchos River.

[b] Channel only. Bottoms overflowed. Overflow ceased at 5.5 feet on gage

[c] Station moved 8 miles farther up Rio Grande and new gage established 16 miles above mouth of Conchos. The new gage heights are not comparable with old.

NOTE.—No measurements were made during March, April, and May.

Discharge measurements of the Rio Grande above Presidio, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
November 17	Jas. P. Hague	135	1.72	3.4	232
November 20	do	109	1.31	3.1	143
November 23	do	101	1.29	3.0	130
November 26	do	98	1.31	3.0	128
November 29	do	90	1.29	2.9	116
December 3	do	213	2.07	3.8	441
December 6	do	320	2.54	4.4	813
December 9	do	291	2.50	4.3	728
December 12	do	328	2.67	4.4	875
December 16	do	227	2.52	4.0	571
December 19	do	204	2.34	3.8	478
December 22	do	251	2.31	4.2	581
December 24	do	228	2.49	4.15	567
December 28	do	216	2.55	4.15	551
December 31	do	192	2.57	4.0	494

Daily gage height, in feet, of Rio Grande above Presidio, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	3.45	4.05	6.25	7.8	7.85	8.15	3.3	1.7	2.8	2.6	3.2
2	3.7	3.55	4.35	6.0	7.85	8.0	7.9	3.95	1.65	2.75	2.6	3.4
3	3.55	3.5	4.75	5.75	8.0	8.1	7.6	2.85	2.0	2.7	2.6	3.8
4	3.5	3.5	4.5	5.95	8.0	8.2	7.3	3.25	2.1	2.7	2.5	4.3
5	3.4	3.65	5.8	6.3	7.9	8.25	6.8	3.6	2.45	2.7	2.55	4.4
6	3.4	3.7	6.3	6.45	8.1	8.5	6.6	2.9	1.7	2.7	2.6	4.4
7	3.4	3.65	6.6	6.25	8.1	8.6	6.45	2.85	5.95	2.7	2.6	4.45
8	3.4	3.55	7.45	6.2	8.1	8.75	6.15	2.7	4.15	2.7	2.65	4.3
9	3.4	3.5	7.25	6.1	7.9	8.8	5.75	2.85	5.6	2.7	3.55	4.3
10	3.4	3.55	7.4	6.25	7.75	8.85	5.3	2.65	3.15	2.7	3.5	4.2
11	3.4	3.55	7.8	5.85	7.65	8.9	4.95	2.55	2.8	2.7	3.4	4.25
12	3.3	3.4	7.9	5.5	7.7	8.85	4.7	2.6	3.05	2.7	3.6	4.35
13	3.3	3.5	8.0	5.3	8.0	9.05	4.5	2.9	2.95	2.7	3.55	4.1
14	3.3	3.6	8.15	5.0	8.0	9.05	4.15	2.6	2.25	2.7	3.45	4.0
15	3.45	3.55	8.2	4.9	8.1	8.8	7.65	2.6	1.7	2.7	3.75	4.05
16	3.6	3.8	8.0	5.15	8.05	8.75	5.8	2.9	1.55	2.7	3.65	3.95
17	3.95	3.9	8.2	5.6	8.2	8.8	6.7	3.9	1.65	2.7	3.45	3.8
18	4.25	4.0	7.95	6.15	8.15	8.5	4.75	3.35	1.5	2.7	3.5	3.85
19	4.15	3.75	7.85	6.9	8.2	8.75	6.45	2.95	2.15	2.7	3.4	3.8
20	4.0	3.6	7.8	7.65	8.25	8.7	8.05	3.1	1.65	2.7	3.15	4.15
21	3.95	3.7	7.55	7.6	7.65	8.65	5.2	2.8	1.5	2.7	3.1	4.25
22	3.9	3.6	7.3	7.75	7.8	8.8	4.0	2.7	1.4	2.7	3.1	4.2
23	3.8	3.55	7.45	7.7	7.65	8.65	4.85	2.6	1.2	2.7	3.0	4.2
24	3.8	3.4	7.65	7.45	7.5	8.55	5.5	2.35	1.2	2.7	3.0	4.15
25	3.75	4.25	7.65	7.4	7.5	8.5	6.55	2.25	1.2	2.6	3.0	4.15
26	3.7	4.25	7.55	7.4	7.5	8.45	4.45	2.0	[a] 3.0	2.6	3.0	4.2
27	3.75	4.15	7.2	7.75	7.55	7.95	3.65	2.15	3.0	2.6	3.0	4.25
28	3.6	4.1	6.7	7.85	7.6	7.7	3.65	1.8	2.9	2.6	3.0	4.15
29	3.6	.....	6.4	8.0	7.5	7.55	3.6	1.9	2.9	2.6	2.95	4.1
30	3.55	.....	6.35	7.85	7.6	7.8	3.6	2.35	2.8	2.6	2.9	4.05
31	3.5	.....	6.3	.....	7.75	.....	3.6	1.85	.....	2.6	.....	4.0

[a] September 26 this station was moved 8 miles farther up the Rio Grande and a new gage was established. The new gage heights are not comparable with the old.

Daily discharge, in second-feet, of Rio Grande above Presidio, Tex., for 1905.

Day.	Jan.	Feb.	Mar.[a]	Apr.[b]	May.[c]	June.[d]	July.[e]	Aug.	Sept.	Oct.	Nov.	Dec.
1	355	330	580	1,580	2,750	5,850	/6,400	740	180	100	/50	225
2	355	/355	650	1,470	2,850	6,200	5,400	/1,000	/170	/95	50	295
3	/325	340	800	1,370	3,100	6,500	4,200	575	240	85	50	/440
4	315	340	700	1,510	3,200	6,900	3,600	745	260	80	35	755
5	295	/385	1,310	1,730	3,200	7,480	/2,970	/890	/330	/80	/40	815
6	/295	400	1,580	1,850	3,500	8,860	2,730	595	180	80	50	/815
7	290	380	1,760	1,730	3,600	9,640	2,580	575	/2,260	85	50	855
8	285	/340	2,310	1,700	3,700	10,620	/2,280	/510	1,070	/90	/60	730
9	/280	325	2,180	1,640	3,600	11,200	1,880	595	1,910	90	270	/730
10	280	345	2,270	1,730	3,550	11,780	1,610	/535	/620	90	255	670
11	280	/350	2,810	1,510	3,550	12,360	/1,420	460	550	/90	/225	735
12	/265	315	2,960	1,340	3,700	12,540	1,350	445	600	85	295	/835
13	265	335	3,110	1,240	4,100	13,700	1,300	/515	/575	80	280	645
14	265	/360	3,330	1,090	4,200	13,700	/1,210	415	350	/75	/245	570
15	/305	345	3,430	1,040	4,400	12,600	4,200	415	170	75	335	610
16	345	480	3,110	1,160	4,450	12,400	2,030	/515	120	75	305	/535
17	515	/540	3,430	1,390	4,700	/12,600	/3,150	915	165	/75	/245	480
18	/660	590	3,030	1,670	4,750	11,400	1,370	700	/135	75	260	505
19	615	460	2,880	2,120	4,900	12,300	/2,850	/545	320	75	230	/480
20	570	/380	2,810	2,640	5,050	12,100	5,000	600	160	/80	/160	570
21	/555	430	2,430	2,610	4,550	/11,900	/1,540	530	/110	80	145	595
22	525	380	2,220	2,710	4,800	12,500	1,070	/500	110	75	145	/580
23	470	355	2,320	2,680	4,750	11,900	1,410	475	100	/75	/130	580
24	/470	315	2,580	2,500	4,700	/11,500	/1,810	410	110	75	130	/565
25	430	680	2,580	2,470	4,800	10,800	3,000	/365	120	60	130	560
26	390	680	2,430	2,470	4,900	10,100	1,250	245	/120	55	/130	585
27	/430	640	2,150	2,710	5,050	/7,600	/930	/325	120	55	130	610
28	375	620	1,820	2,780	5,200	6,100	930	210	110	50	130	/550
29	375	.....	1,640	2,890	5,200	5,500	910	245	/110	/50	/120	530
30	/370	.....	1,610	2,780	5,400	6,000	/910	/390	100	50	115	510
31	355	.....	1,580	.....	5,650	.....	910	230	.....	50	.....	/495

[a] Discharge computed from former measurements and checked by discharge of the lower Presidio station.

[b] Discharge computed from measurements of June and July, 1903.

[c] Water flowing across bottoms during the whole month. Discharge computed from those of the lower Presidio station, due allowance being made for flow of Rio Conchos.

[d] Over 50 per cent of the water passing this station during June was outside of channel. Discharges obtained by combining gage heights with flow at the lower Presidio station and of the Conchos.

[e] Discharge for gage heights above 5.5 feet when water leaves main channel above station and flows across bottom was obtained by combining gage height with flow at the lower Presidio station and of the Conchos.

/ Meter measurements.

Estimated monthly discharge of Rio Grande above Presidio, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	660	265	384	23,613
February	680	315	421	23,395
March	3,430	580	2,206	135,669
April	2,890	1,040	1,937	115,259
May	5,650	2,750	4,253	261,521
June	13,700	5,500	10,154	604,225
July	6,400	910	2,329	143,307
August	1,000	210	523	32,152
September	2,260	100	382	22,760
October	100	50	75	4,611
November	335	35	160	9,511
December	855	225	595	36,605
The year	13,700	35	1,952	1,412,548

RIO CONCHOS NEAR OJINAGA, MEXICO.

Discharge measurements of Rio Conchas 2 miles above mouth, near Ojinaga, Mexico.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1905.		*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 18	Jas. P. Hague	527	1.77	2.5	935
June 22	do	472	1.26	2.2	594
July 4	do	294	.97	1.5	285

NOTE.—Above measurements made to determine the inflow between the upper and lower Presidio stations.

RIO GRANDE BELOW PRESIDIO, TEX.

This station was established April 8, 1900, by the International (Water) Boundary Commission. It is 6 miles below Presidio; also below the mouth of Rio Conchos and about 215 miles below El Paso. It is at the west end of the canyon section of the Rio Grande. The discharge at this station minus the discharge at the station above Presidio, Tex., is the discharge of Rio Conchos, except at rare intervals, when some rain water enters the Rio Grande from the north.

The river is fairly straight at the station and for one-fourth mile above and below. The right bank is a rocky bluff. The left bank is an alluvial deposit and overflows for 750 feet back from the river, where gravel hills are found. The bed is shifting sand and is affected by a drainage line called Alamos Creek, which reaches the river one-fourth mile below the station. This is subject to torrential floods, which bring large quantities of bowlders and gravel into the Rio Grande, forming a temporary dam. This remains, throwing backwater onto the gage, until a flood in the river scours it out.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire. The tagged wire is extended across the bottom on the Texas side to the foot of the gravel hills. The initial point for soundings is the tagged-wire support at the hills on the left bank. A boat is provided for measuring flood flow across the bottom.

The gage is an inclined scantling bolted to posts sunk into the ground. There is an overflow gage at the gravel hills. This consists of a vertical staff nailed to a tree. The range between low and high water is about 23 feet. The highest recorded gage height is 26.35 feet, September 11, 1904. The extreme floods come from the Conchos. The bottom

overflows at 13 feet on the gage. The bench mark is the top of a pine post sunk in the ground at the foot of the gravel hills at the left end of the tagged wire; elevation, 13.55 feet above the datum of the gage.

The observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is James P. Hague, and the gage reader, Felicitas Gonzales.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Papers):

Description: WS 50, p 355; 66, p 74; 84, p 175; 99, p 368; 132, p 75.
Discharge: WS 50, p 356; 66, p 74; 84, pp 175-176; 99, pp 369-372; 132, pp 75-78.
Discharge, mean daily: WS 132, p 79.
Discharge, monthly: Ann 22, iv, p 355; WS 75, p 158; WS 84, p 177; 99, p 373; 132, p 79.
Gage heights: WS 50, p 356; 66, p 75; 84, pp 176-177; 99, p 372; 132, p 78.
Hydrograph: WS 75, p 159.

Discharge measurements of Rio Grande below Presidio, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	Jas. P. Hague	851	1.62	6.9	1,376
January 5	do	772	1.40	6.7	1,078
January 8	do	766	1.43	6.65	1,096
January 11	do	756	1.42	6.55	1,071
January 14	do	730	1.33	6.5	971
January 17	do	741	1.34	6.55	995
January 20	do	878	1.71	7.05	1,502
January 23	do	859	1.64	6.9	1,407
January 26	do	751	1.57	6.8	1,176
January 29	do	656	1.49	6.6	978
January 31	do	690	1.34	6.45	925
February 3	do	656	1.37	6.4	899
February 6	do	638	1.33	6.4	848
February 9	do	611	1.30	6.35	795
February 12	do	595	1.30	6.25	774
February 15	do	580	1.25	6.1	724
February 18	do	838	1.63	6.9	1,366
February 21	do	976	1.99	7.5	1,945
June 20	do	2,582	4.86	11.25	12,541
June 23	do	2,568	4.86	11.2	12,473
June 26	do	2,320	4.58	10.45	10,622
June 29	do	1,867	3.46	9.3	6,456
July 3	do	1,680	2.37	8.3	3,980
July 7	do	1,582	2.03	7.9	3,219
July 10	do	1,321	1.57	7.5	2,073
July 13	do	1,224	1.37	7.2	1,677
July 16	do	1,346	1.64	7.65	2,202
July 18	do	1,752	3.57	8.85	6,249
July 20	do	2,294	4.41	10.2	10,128
July 22	do	2,229	4.45	10.1	9,910
July 25	do	2,652	5.55	11.2	14,715
July 28	do	2,705	6.05	11.65	16,355
August 1	do	2,259	4.62	10.3	10,432
August 4	do	1,548	2.78	8.6	4,303
August 7	do	1,540	2.80	8.6	4,305
August 9	do	1,468	2.61	8.4	3,836
August 12	do	1,467	2.70	8.5	3,966
August 15	do	1,857	5.02	10.0	9,319

Discharge measurements of Rio Grande below Presidio, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
August 18	Jas. P. Hague	2,767	5.89	11.7	16,301
August 21	do	1,888	4.72	10.0	8,906
August 24	do	1,783	4.52	9.7	8,058
August 26	do	1,722	4.74	9.75	8,164
August 28	do	1,568	3.82	8.9	5,994
August 31	do	1,300	2.51	8.1	3,261
September 3	do	914	2.68	7.6	2,449
September 6	do	944	2.78	7.6	2,622
September 11	do	2,313	4.82	10.65	11,150
September 14	do	2,303	4.70	10.55	10,827
September 17	do	1,780	4.59	9.8	8,179
September 20	do	1,085	3.81	8.55	4,135
September 23	do	2,933	7.06	12.3	20,719
September 27	do	2,407	5.20	10.95	12,520
September 30	do	2,430	5.34	11.05	12,984
October 3	do	2,718	5.72	11.45	15,550
October 6	do	2,553	5.38	11.1	13,728
October 9	do	1,641	4.05	8.95	6,645
October 12	do	1,588	3.59	8.6	5,703
October 15	do	1,056	2.88	7.9	3,042
October 18	do	1,126	2.48	7.7	2,791
October 21	do	1,164	2.06	7.5	2,402
October 24	do	1,002	1.85	7.2	1,857
October 28	do	972	1.54	7.0	1,501
October 31	do	954	1.41	7.0	1,347
November 3	do	866	1.50	6.75	1,295
November 7	do	1,489	3.69	8.75	5,501
November 10	do	2,265	4.83	10.75	10,940
November 13	do	1,547	4.73	9.4	7,319
November 16	do	1,420	4.63	9.15	6,568
November 19	do	1,489	4.80	9.3	7,143
November 22	do	1,377	3.72	8.65	5,119
November 25	do	1,131	2.66	7.9	3,008
November 28	do	1,076	2.59	7.65	2,787
December 2	do	1,548	4.45	9.2	6,891
December 5	do	1,312	4.04	8.6	5,306
December 8	do	1,140	3.49	8.2	3,975
December 10	do	1,016	3.17	7.9	3,224
December 14	do	908	2.82	7.6	2,558
December 17	do	1,438	4.39	9.1	6,318
December 20	do	1,491	4.68	9.2	6,974
December 23	do	1,610	4.82	9.45	7,760
December 27	do	1,317	4.12	8.6	5,430
December 30	do	1,262	2.91	8.1	3,677

Daily gage height, in feet, of Rio Grande below Presidio, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.9	6.4	7.35	7.75	8.15	9.3	9.45	10.3	7.95	10.5	6.9	7.7
2	6.85	6.4	7.3	7.6	8.3	9.35	8.8	9.75	7.85	11.4	6.8	9.3
3	6.8	6.4	7.35	7.6	8.45	9.4	8.4	9.1	7.6	11.2	6.75	9.4
4	6.8	6.4	7.15	7.5	8.3	9.6	8.3	8.8	7.6	10.6	6.7	8.7
5	6.75	6.4	7.4	7.45	8.35	9.85	8.2	8.75	7.75	10.75	6.95	8.55
6	6.7	6.4	7.85	7.65	8.45	10.05	8.15	8.6	7.75	11.3	7.7	8.45
7	6.7	6.5	7.95	7.7	8.5	10.35	7.9	8.55	9.4	11.0	8.8	8.25
8	6.65	6.45	8.1	7.65	8.55	10.5	7.6	8.5	9.55	9.75	9.8	8.15
9	6.6	6.35	8.15	7.65	8.5	10.75	7.65	8.35	11.35	9.05	10.3	8.0
10	6.6	6.3	8.1	7.65	8.65	11.15	7.55	8.5	11.3	8.85	10.7	7.85
11	6.55	6.3	8.15	7.6	8.6	11.55	7.5	8.6	10.75	8.65	11.6	7.8
12	6.5	6.25	8.25	7.45	8.55	11.7	7.3	8.55	10.7	8.6	10.75	7.75
13	6.5	6.1	8.2	7.4	8.6	12.15	7.2	9.05	10.45	8.3	9.3	7.7
14	6.5	6.1	8.25	7.4	8.7	12.6	7.2	9.6	10.45	8.1	9.3	7.6
15	6.5	6.1	8.4	7.4	8.8	12.35	8.8	10.2	10.45	7.9	9.55	8.05
16	6.5	6.3	8.3	7.35	8.8	12.0	7.8	10.0	10.05	7.75	9.2	8.85
17	6.55	6.95	8.6	7.4	8.9	11.35	10.35	10.45	9.75	7.7	9.4	9.15
18	6.7	6.85	8.6	7.7	8.95	11.15	8.45	11.7	9.05	7.7	9.6	9.5
19	6.85	7.45	8.45	7.8	8.95	11.25	9.4	10.9	8.85	7.65	9.2	10.0
20	7.05	7.45	8.45	7.9	9.0	11.3	10.65	10.5	8.55	7.6	9.1	9.5
21	6.9	7.5	8.35	8.1	8.95	11.35	10.2	10.0	8.7	7.5	8.9	9.75
22	6.9	7.4	8.15	8.1	9.0	11.45	9.85	9.65	9.65	7.45	8.55	10.0
23	6.9	7.5	8.1	7.85	9.25	11.25	10.6	9.75	11.95	7.35	8.25	9.4
24	6.9	7.2	8.05	7.8	9.05	11.05	10.6	9.8	13.35	7.25	8.2	9.0
25	6.8	7.2	8.2	7.8	8.9	10.8	11.25	10.2	14.45	7.2	8.05	8.75
26	6.8	7.4	8.15	7.95	8.9	10.5	11.4	9.75	13.25	7.15	7.8	8.65
27	6.75	7.5	8.15	8.0	9.05	9.85	11.55	9.5	10.9	7.1	7.75	8.6
28	6.7	7.45	8.1	8.15	9.2	9.4	11.75	9.0	10.3	7.0	7.65	8.45
29	6.6	.....	7.9	8.1	9.1	9.3	11.05	8.5	10.35	7.0	7.55	8.35
30	6.5	.....	7.8	8.15	9.0	9.3	10.55	8.35	11.3	7.0	7.7	8.15
31	6.45	.....	7.7	.....	9.15	.....	10.3	8.15	.....	7.0	.....	8.0

Daily discharge, in second-feet, of Rio Grande below Presidio, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.[a]	May.[a]	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,360	900	2,050	2,630	2,970	6,400	6,830	[b]10,430	3,000	11,750	1,320	2,840
2	[b]1,330	900	1,980	2,410	3,270	6,580	5,220	8,440	2,850	15,200	1,300	[b]7,160
3	1,250	[b]900	2,050	2,380	3,650	6,770	[b]4,230	6,100	[b]2,450	[b]14,130	[b]1,290	7,420
4	1,220	880	1,750	2,230	3,270	7,510	3,980	[b]5,020	2,510	12,080	1,270	5,560
5	[b]1,130	860	2,130	2,140	3,390	8,450	3,790	4,840	2,810	12,570	1,710	[b]5,150
6	1,100	[b]850	2,840	2,350	3,650	9,210	3,690	4,300	[b]2,870	[b]14,530	3,300	4,810
7	1,120	950	3,000	2,390	3,800	10,330	[b]3,220	[b]4,190	7,680	13,400	[b]5,640	4,140
8	[b]1,100	900	3,250	2,290	3,940	10,800	2,360	4,070	8,100	9,280	8,360	[b]3,850
9	1,090	[b]800	3,330	2,260	3,800	11,400	2,500	[b]3,670	13,140	[b]6,970	9,720	3,480
10	1,080	790	3,250	2,260	4,230	12,360	[b]2,210	4,070	13,000	6,370	[b]10,810	[b]3,110
11	[b]1,070	790	3,330	2,200	4,090	13,410	2,070	4,300	[b]11,440	5,830	13,500	3,000
12	1,010	[b]770	3,500	2,020	3,940	13,880	1,810	[b]4,140	11,300	[b]5,700	10,940	2,880
13	990	720	3,420	1,960	4,090	15,410	[b]1,680	5,930	10,500	4,610	[b]7,020	2,780
14	[b]970	720	3,500	1,960	4,380	16,940	1,680	7,900	[b]10,500	3,820	7,020	[b]2,560
15	970	[b]720	3,760	1,960	4,670	16,090	6,080	[b]10,100	10,500	[b]3,040	7,770	3,680
16	970	880	3,590	1,900	4,670	14,900	[b]2,650	9,320	9,080	2,860	[b]6,720	5,680
17	[b]1,000	1,400	4,110	1,960	4,980	12,850	10,730	11,100	[b]8,010	2,790	7,440	[b]6,420
18	1,150	1,320	4,110	2,330	5,140	12,340	[b]4,910	[b]16,300	5,750	[b]2,790	8,040	7,360
19	1,300	1,900	3,840	2,460	5,140	12,560	7,830	12,600	5,100	2,690	[b]6,840	8,840
20	[b]1,500	1,900	3,840	2,600	5,310	[b]12,660	[b]11,930	10,900	[b]4,130	2,590	6,530	[b]7,720
21	1,410	[b]1,950	3,670	2,890	5,140	12,810	10,130	[b]8,910	4,610	[b]2,400	5,900	8,400
22	1,410	1,870	3,330	2,890	5,310	13,100	[b]9,160	7,920	8,790	2,310	[b]4,840	9,080
23	[b]1,410	1,990	3,250	2,530	6,210	[b]12,600	12,080	8,200	[b]19,140	2,130	4,000	[b]7,630
24	1,360	1,710	3,160	2,460	5,490	12,120	12,080	[b]8,340	23,870	[b]1,950	3,850	6,520
25	1,220	1,730	3,420	2,460	4,980	11,510	[b]14,900	9,700	27,170	1,860	[b]3,430	5,530
26	[b]1,180	1,950	3,330	2,670	4,980	[b]10,770	15,440	[b]8,160	22,130	1,770	2,920	5,560
27	1,130	2,070	3,330	2,740	5,490	8,470	15,990	7,520	[b]12,300	1,680	2,880	[b]5,430
28	1,080	2,040	3,250	2,970	6,030	6,810	[b]16,750	[b]6,250	9,540	[b]1,500	[b]2,790	4,900
29	[b]980	.....	2,920	2,890	5,670	[b]6,460	13,960	4,800	9,770	1,450	2,690	4,550
30	950	.....	2,760	2,970	5,310	6,460	11,960	4,120	14,130	[b]1,400	2,880	[b]3,820
31	[b]930	.....	2,600	.....	5,850	.....	10,960	[b]3,430	.....	1,350	.....	3,530

[a] Daily discharges computed from measurements of November, 1904, and June, 1905.
[b] Meter measurements.

Estimated monthly discharge of Rio Grande below Presidio, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,500	930	1,154	70,949
February	2,070	720	1,256	69,739
March	4,110	1,750	3,150	193,686
April	2,970	1,900	2,405	143,127
May	6,210	2,970	4,608	283,319
June	16,940	6,400	11,065	658,433
July	16,750	1,680	7,510	461,772
August	16,300	3,430	7,260	446,430
September	27,170	2,450	9,872	587,445
October	15,200	1,350	5,574	342,744
November	13,500	1,270	5,424	322,750
December	9,080	2,560	5,286	325,031
The year	27,170	720	5,380	3,905,415

RIO GRANDE NEAR LANGTRY, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is located one-half mile south of Langtry station, on the southern Pacific Railroad, and is about 440 miles below El Paso, Tex., at the east end of the canyon section of the Rio Grande, and a short distance to the west of the mouth of Pecos River, one of the principal tributaries of the Rio Grande.

The river is nearly straight for 1 mile above and one-half mile below the station. The right (Mexican) bank is a rock bluff. The left bank is alluvial deposit for 200 feet back to a rock bluff. The bed of the river is shifting sand, as is also the left bank.

Discharge measurements are made by means of a cable of 490 feet span, car, tagged wire, and guy wire. The initial point for soundings is the pole supporting the cable on the left bank.

The gage is a vertical staff, bolted to the bluff on the right bank. It is read from the left bank with the aid of field glasses. The range between high and low water is about 36 feet. The highest recorded gage is 36.5 feet, September 13, 1904. The bottom begins to overflow at gage height 29.5 feet and the overflow extends 110 feet back from the cable pole. This bottom is densely wooded. The bench mark is a cross cut on a large bowlder at the bluff on the Texas side, in line with the cable; elevation, 40.56 feet above the datum of the gage.

Observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer was E. E. Winter and the gage reader was W. H. Dodd.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, p 357; 66, p 75; 84, p 172; 99, p 365; 132, p 80.
Discharge: WS 50, p 357; 66, pp 75-76; 84, pp 172-173; 99, pp 365-367; 132, pp 80-81.
Discharge, mean daily: WS 132, p 83.
Discharge, monthly: Ann 22, iv, p 355; WS 75, p 160; 84, p 174; 99, p 368; 132, p 83.
Gage heights: WS 50, p 358; 66, p 76; 84, p 174; 99, pp 367-368; 132, p 82.

Discharge measurements of Rio Grande near Langtry, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	E. E. Winter	658	2.36	1.6	1,552
January 6	do	642	2.30	1.55	1,474
January 11	do	618	2.02	1.4	1,248
January 14	do	625	1.93	1.3	1,207
January 19	do	585	1.88	1.1	1,097
January 23	do	628	2.06	1.4	1,296
January 28	do	587	2.10	1.5	1,234
February 2	do	607	1.72	1.3	1,045
February 6	do	568	1.62	1.2	922
February 10	do	571	1.59	1.2	909
February 14	do	531	2.02	1.1	1,070
February 18	do	520	1.95	1.0	1,012
February 25	do	713	2.71	1.9	1,932
March 6	do	840	2.49	2.2	2,091
March 10	do	1,162	3.28	3.1	3,810
March 15	do	1,187	3.21	3.3	3,810
March 19	do	944	3.00	3.0	2,831
March 23	do	968	3.07	3.0	2,976
March 28	do	883	2.83	2.7	2,496
April 3	do	732	2.46	2.3	1,800

Discharge measurements of Rio Grande near Langtry, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
April 7	E. E. Winter	789	2.62	2.0	2,068
April 11	do	774	2.84	1.9	2,200
April 15	do	777	2.94	1.9	2,283
April 20	do	791	2.99	1.7	2,365
April 24	do	956	2.99	2.4	2,860
April 27	do	889	2.97	2.4	2,640
May 2	do	957	3.14	2.6	3,005
May 6	do	1,037	3.59	2.7	3,728
May 10[a]	do	868	2.86	3.4	2,486
May 15	do	1,087	3.57	3.3	3,881
May 19	do	1,158	4.11	3.4	4,763
May 24	do	1,184	3.81	3.5	4,509
May 29	do	1,175	3.55	3.4	4,170
June 2	do	1,120	4.25	3.8	4,759
June 8	do	1,532	5.01	5.2	7,671
June 12	do	2,344	5.66	6.8	13,278
June 16	do	3,167	5.96	8.5	18,887
June 20	do	2,538	5.09	7.1	12,925
June 24	do	2,481	5.28	7.3	13,105
June 28	do	1,718	4.38	5.9	7,524
July 3	do	1,129	4.06	4.1	4,589
July 8	do	984	3.58	2.8	3,518
July 14	do	760	3.25	2.0	2,472
July 19	do	1,056	3.36	3.2	3,550
July 24	do	1,403	4.65	4.8	6,524
July 29	do	1,659	5.16	6.1	8,567
August 4	do	1,350	4.45	3.9	6,004
August 10	do	1,126	3.55	3.2	4,002
August 14	do	1,658	4.67	5.2	7,743
August 19	do	1,724	4.92	5.55	8,480
August 24	do	1,433	4.74	4.4	6,788
August 28	do	1,444	4.75	4.5	6,864
September 2	do	997	3.61	2.7	3,597
September 7	do	848	3.47	2.15	2,942
September 10	do	1,643	4.52	5.65	7,431
September 16	do	1,355	3.95	4.4	5,350
September 22	do	1,017	3.72	3.0	3,785
September 25	do	1,672	4.78	5.65	7,984
September 28	do	3,324	7.13	10.85	23,694
October 2	do	1,693	5.16	6.35	8,731
October 6	do	1,355	4.88	5.0	6,609
October 10	do	1,310	4.71	4.65	6,169
October 14	do	1,035	3.71	3.25	3,840
October 19	do	980	3.52	2.5	3,453
October 23	do	818	3.34	2.0	2,733
October 28	do	766	2.98	1.7	2,283
November 2	do	769	2.62	1.6	2,012
November 6	do	751	1.87	1.3	1,407
November 9	do	733	1.80	1.3	1,320
November 13	do	1,004	3.13	2.7	3,145
November 17	do	1,302	3.52	4.0	4,583
November 21	do	1,342	3.64	4.1	4,888

[a] Channel filled with mud washed in by local rains.

Discharge measurements of Rio Grande near Langtry, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square Feet.	*Feet per second.*	*Feet.*	*Second-feet.*
November 28	E. E. Winter	942	3.74	2.4	3,523
November 30	do	784	3.70	2.0	2,902
December 3	H. F. Collins	839	3.87	2.1	3,248
December 9	do	1,047	3.83	2.85	4,008
December 12	do	931	3.75	2.2	3,493
December 17	do	817	3.59	2.0	2,937
December 20	do	1,500	5.62	4.2	8,434
December 25	do	1,589	5.85	4.6	9,299
December 31	do	990	4.19	2.7	4,144

Daily gage height, in feet, of Rio Grande near Langtry, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.4	1.9	5.4	2.45	3.5	10.2	5.2	2.95	5.5	1.6	1.9
2	1.7	1.25	1.9	2.6	2.6	3.85	5.35	4.8	2.65	6.75	1.6	1.9
3	1.6	1.2	1.9	2.4	2.6	3.8	4.2	4.1	2.55	7.3	1.55	2.05
4	1.6	1.15	1.95	2.25	2.6	3.9	3.7	3.9	2.5	6.4	1.5	3.2
5	1.6	1.05	2.3	2.15	2.65	3.9	3.65	3.75	2.55	5.4	1.45	3.85
6	1.55	1.15	2.3	2.0	2.7	4.05	3.55	3.5	2.15	4.9	1.3	3.55
7	1.5	1.05	2.3	2.0	2.7	4.55	2.8	3.45	2.15	5.7	1.3	3.4
8	1.5	1.1	2.5	2.0	2.8	5.25	2.8	3.35	2.7	6.65	1.3	3.15
9	1.5	1.2	4.35	2.05	5.1	5.7	2.65	3.2	2.9	5.55	1.3	2.85
10	1.45	1.15	3.05	2.05	3.45	5.65	2.4	3.2	6.25	4.6	1.3	2.55
11	1.4	1.1	2.8	1.95	3.2	5.8	2.25	3.1	9.5	4.15	1.3	2.4
12	1.4	1.1	2.8	1.9	3.7	6.95	2.2	2.9	5.4	3.75	1.3	2.25
13	1.3	1.1	2.9	1.9	4.0	7.0	2.1	5.95	5.1	3.6	2.0	2.2
14	1.3	1.1	2.9	1.9	3.95	7.7	2.0	5.1	4.5	3.15	4.3	2.1
15	1.3	1.1	3.35	1.9	3.35	8.15	1.95	5.35	4.4	2.95	7.0	2.1
16	1.25	1.0	3.1	1.9	3.25	8.65	1.9	5.75	4.4	2.85	4.55	2.0
17	1.2	1.0	3.0	1.8	3.3	8.3	2.15	6.3	4.95	2.8	4.0	2.0
18	1.2	1.0	3.0	1.7	3.3	7.1	3.25	5.55	4.8	2.5	4.5	2.55
19	1.1	1.0	3.0	1.7	3.35	7.35	3.25	6.25	3.95	2.45	4.6	4.0
20	1.1	1.0	3.05	1.7	3.4	7.15	3.75	6.7	3.5	2.25	4.15	4.25
21	1.1	1.2	3.25	1.7	3.5	7.3	3.9	7.05	3.05	2.1	4.05	4.2
22	1.1	1.4	3.1	1.7	3.5	7.2	4.65	5.95	2.9	2.0	3.7	4.0
23	1.25	2.0	3.0	2.35	3.5	7.25	5.35	4.65	2.7	1.95	3.2	4.5
24	1.7	1.9	2.9	2.4	4.15	7.25	4.85	4.35	2.7	1.9	2.8	5.25
25	1.65	1.85	2.75	2.4	3.7	7.1	7.55	5.65	5.6	1.8	2.55	4.6
26	1.6	1.8	2.7	2.4	3.5	7.0	5.4	5.15	8.4	1.8	2.4	3.9
27	1.6	1.8	2.7	2.4	3.5	6.3	5.3	4.95	10.4	1.75	2.4	3.6
28	1.5	1.8	2.7	2.75	3.4	5.65	5.5	4.5	10.3	1.7	2.35	3.25
29	1.5	.....	2.7	2.55	3.6	7.5	6.15	4.05	6.6	1.6	2.2	3.05
30	1.45	.....	2.7	2.4	3.45	11.1	6.4	3.65	5.65	1.6	1.95	2.85
31	1.4	.....	2.5	.....	3.5	.....	6.15	3.3	.....	1.6	.....	2.7

Daily discharge, in second-feet, of Rio Grande near Langtry, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,350	1,130	1,930	7,700	2,700	4,370	25,700	7,520	4,000	7,830	2,100	2,760
2	[a]1,550	[a]990	1,930	2,100	3,000	[a]4,860	6,420	7,050	[a]3,540	[a]9,930	[a]2,010	2,760
3	1,550	930	1,930	[a]1,900	3,130	4,760	[a]4,690	6,230	3,420	11,580	1,910	[a]3,130
4	1,550	870	1,960	1,890	3,260	4,960	4,260	[a]6,000	3,360	8,880	1,810	4,350
5	1,550	760	2,190	1,930	3,490	4,960	4,220	5,600	3,420	7,240	1,710	5,000
6	[a]1,470	[a]880	[a]2,190	1,920	[a]3,730	5,270	4,140	5,000	2,940	[a]6,480	[a]1,410	4,700
7	1,400	820	2,280	[a]2,070	3,730	6,310	3,520	4,800	[a]2,940	7,800	1,380	4,550
8	1,400	850	2,660	2,130	3,930	[a]7,770	[a]3,520	4,500	3,600	9,630	1,350	4,300
9	1,400	910	6,690	2,220	6,530	9,420	3,320	4,100	3,850	7,580	[a]1,320	[a]4,010
10	1,320	[a]880	[a]3,710	2,280	[a]2,590	9,250	3,000	[a]4,000	[a]9,530	[a]6,090	1,300	3,770
11	1,250	910	3,130	[a]2,240	2,410	9,770	2,800	3,800	22,500	5,330	1,280	3,650
12	[a]1,250	960	3,050	2,220	3,730	[a]13,770	2,730	3,400	8,150	4,670	1,260	[a]3,530
13	1,210	1,020	3,170	2,240	4,650	13,940	2,600	9,240	7,320	4,420	[a]2,240	3,490
14	[a]1,210	[a]1,070	3,090	2,260	4,870	16,250	[a]2,470	[a]7,540	5,640	[a]3,780	5,480	3,210
15	1,210	1,070	[a]3,910	[a]2,280	[a]3,980	17,730	2,420	8,050	5,360	3,680	13,880	3,210
16	1,180	1,010	3,310	2,340	3,950	[a]19,380	2,380	8,870	[a]5,360	3,630	6,230	2,940
17	1,150	1,010	3,020	2,300	4,220	18,040	2,600	9,980	6,900	3,600	[a]4,580	[a]2,940
18	1,150	[a]1,010	2,930	2,250	4,390	12,930	3,620	8,480	6,490	3,450	6,080	4,310
19	[a]1,100	1,010	[a]2,830	2,300	[a]4,660	14,000	[a]3,640	[a]9,880	5,200	[a]3,380	6,380	7,940
20	1,100	1,010	2,960	[a]2,360	4,670	[a]12,970	4,570	10,780	4,530	3,090	5,040	[a]8,540
21	1,100	1,210	3,400	2,360	4,780	13,100	4,850	11,480	3,850	2,870	[a]4,850	8,430
22	1,100	1,420	3,140	2,370	4,690	13,010	6,240	9,530	[a]3,670	2,730	4,570	8,000
23	[a]1,200	2,030	[a]2,980	2,820	4,600	13,050	7,540	7,230	3,450	[a]2,650	4,170	9,080
24	1,500	1,930	2,820	[a]2,860	[a]5,810	[a]13,050	[a]3,600	[a]6,700	3,450	2,580	3,850	10,700
25	1,430	[a]1,880	2,580	2,780	4,880	12,300	14,700	9,300	[a]7,900	2,430	3,640	[a]9,300
26	1,370	1,830	2,500	2,710	4,450	11,910	7,460	8,230	16,280	2,430	3,520	7,400
27	1,370	1,830	2,500	[a]2,640	4,420	9,120	7,300	7,800	22,240	2,350	3,520	6,590
28	[a]1,230	1,830	[a]2,500	2,990	4,190	[a]7,020	7,620	[a]6,860	[a]22,030	[a]2,280	[a]3,440	5,640
29	1,230	.....	2,500	2,790	[a]4,570	14,600	[a]8,650	5,960	10,830	2,200	3,210	5,100
30	1,180	.....	2,500	2,640	4,270	29,300	9,170	5,160	7,980	2,200	[a]2,830	4,560
31	1,130	.....	2,180	.....	4,370	.....	8,670	4,460	.....	2,200	.....	[a]4,140

[a] Meter measurements.

Estimated monthly discharge of Rio Grande near Langtry, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,550	1,100	1,296	79,716
February	2,030	760	1,181	65,574
March	6,690	1,930	2,854	175,477
April	7,700	1,890	2,530	150,526
May	6,530	2,410	4,150	255,174
June	29,300	4,370	11,572	688,602
July	25,700	2,380	5,852	359,841
August	11,480	3,400	7,017	431,464
September	22,500	2,940	7,327	436,007
October	11,580	2,200	4,806	295,517
November	13,880	1,260	3,545	210,942
December	10,700	2,760	5,227	321,382
The year	29,300	760	4,780	3,470,222

RIO GRANDE BELOW MOUTH OF DEVILS RIVER, TEXAS.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is alongside the Southern Pacific Railroad track, about a mile below the mouth of Devils River and about 480 miles below El Paso.

The river is nearly straight for 1 mile above and the same distance below the station. The right bank is alluvial deposit, overflowing in extreme high water for a distance of some 500 feet back from the river. The left bank is a loose rock fill along which runs the Southern Pacific Railroad. The bed is rock for a short distance from the left bank; the rest is shifting sand and gravel.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire.

The gage is an inclined scantling spiked to posts set in the ground. The highest flood on record showed watermarks of 36.5 feet on gage; it occurred April 6, 1900, about two weeks before this gage was established. The range between high and low water is about 33 feet. The bench mark is a cross cut on top of the coping stone of a culvert near the gage; elevation, 36.98 feet above the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is E. E. Winter and the gage reader is John Harrison.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, pp 364-365; 66, p 80; 84, p 162; 99, p 345; 132, p 84.
Discharge: WS 50, p 365; 66, p 80; 84, p 162; 99, pp 345-347; 132, pp 84-85.
Discharge, mean daily: WS 132, p 87.
Discharge, monthly: Ann 22, iv, p 357; WS 75, p 161; 84, p 163; 99, p 348; 132, p 88.
Gage heights: WS 50, p 365; 66, p 81; 84, p 163; 99, pp 347-348; 132, p 86.

Discharge measurements of Rio Grande below mouth of Devils River, Texas, in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 4	E. E. Winter	1,267	1.99	3.9	2,524
January 10	do	1,225	1.99	3.8	2,439
January 13	do	1,185	1.91	3.7	2,264
January 18	do	1,171	1.87	3.6	2,187
January 21	do	1,155	1.82	3.6	2,104
January 26	do	1,218	1.98	3.9	2,411
January 31	do	1,175	1.89	3.7	2,225
February 4	do	1,160	1.78	3.6	2,060
February 9	do	1,190	1.78	3.7	2,123
February 13	do	1,150	1.74	3.6	2,005
February 17	do	1,342	1.64	3.6	2,197
February 22	do	1,392	1.72	3.85	2,401
February 28	do	1,566	2.23	4.4	3,485
March 7	do	1,607	2.17	4.6	3,487
March 14	do	1,746	2.51	5.3	4,378
March 18	do	1,887	3.56	6.0	6,715
March 22	do	1,926	3.73	6.2	7,193
March 26	do	1,703	2.64	5.6	4,494
March 31	do	1,602	2.29	5.1	3,671
April 6	do	1,570	2.58	4.7	4,050
April 10	do	1,531	2.87	4.5	4,400
April 14	do	1,468	2.84	4.4	4,167
April 19	do	1,385	2.28	4.0	3,152
April 22	do	1,402	2.41	4.25	3,382
April 26	do	1,790	2.84	5.5	5,078

Discharge measurements of Rio Grande below mouth of Devils River, etc.—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
April 30	E. E. Winter	2,170	3.24	6.7	7,024
May 5	do	1,741	3.03	5.7	5,274
May 9	do	1,930	3.15	5.9	6,066
May 13	do	1,774	3.04	5.7	5,387
May 18	do	1,977	3.38	6.0	6,690
May 22	do	2,122	3.11	5.9	6,603
May 26	do	2,203	3.27	6.2	7,214
May 31	do	2,260	3.68	6.4	8,306
June 6	do	2,386	3.44	6.6	8,202
June 10	do	2,717	4.59	7.5	12,475
June 15	do	3,101	5.08	9.4	15,764
June 19	do	3,410	6.12	9.5	20,879
June 23	do	3,336	6.16	9.0	20,564
June 27	do	3,034	5.15	8.4	15,628
June 29	do	10,582	8.05	21.9	85,148
July 6	do	2,321	3.94	6.7	9,144
July 12	do	2,062	3.08	5.9	6,343
July 17	do	1,575	2.44	4.7	3,844
July 22	do	2,223	3.68	6.5	8,179
July 26	do	2,285	4.09	7.05	9,344
July 31	do	3,088	5.12	8.6	15,796
August 8	do	2,610	4.03	6.9	10,525
August 12	do	2,550	4.40	7.0	11,210
August 17	do	3,063	5.14	8.6	15,746
August 23	do	2,700	4.69	7.5	12,660
August 26	do	2,697	4.60	7.3	12,419
August 31	do	2,279	4.08	6.2	9,287
September 5	do	1,736	3.03	5.2	5,254
September 12	do	2,930	4.46	8.15	13,060
September 18	do	2,373	3.91	6.9	9,282
September 24	do	1,769	3.40	5.4	6,022
September 27	do	3,423	5.84	9.95	20,000
September 30	do	2,682	5.08	7.95	13,619
October 5	do	2,568	4.59	7.55	11,785
October 9	do	2,502	4.41	7.25	11,027
October 13	do	2,178	4.04	6.5	8,807
October 18	do	1,715	3.36	5.1	5,770
October 21	do	1,388	3.19	4.8	4,426
October 26	do	1,268	3.06	4.4	3,875
October 31	do	1,169	2.88	4.1	3,366
November 5	do	1,258	2.35	4.0	2,951
November 8	do	1,214	2.19	3.95	2,659
November 12	do	1,256	2.40	4.0	3,013
November 15	do	2,826	5.54	8.45	15,664
November 20	do	2,181	4.77	6.8	10,397
November 24	do	1,905	4.34	5.8	8,265
November 29	do	1,442	3.81	4.9	5,489
December 6	H. F. Collins	1,879	5.18	6.3	9,728
December 11	do	1,578	4.04	6.1	6,371
December 15	do	1,449	3.83	5.2	5,543
December 19	do	1,426	3.77	5.3	5,371
December 24	do	2,360	5.70	7.45	13,442
December 27	do	1,884	4.79	6.2	9,027

Daily gage height, in feet, of Rio Grande below mouth of Devils River, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	3.7	4.25	8.0	6.25	6.35	10.7	7.85	5.65	7.2	4.1	4.65
2	4.0	3.65	4.35	7.1	5.85	6.7	10.7	7.6	5.5	7.75	4.1	4.6
3	3.95	3.6	4.4	5.5	5.75	6.5	10.1	7.6	5.5	9.0	4.15	4.5
4	3.9	3.55	4.4	5.05	5.7	6.55	7.25	7.35	5.4	8.45	4.1	4.5
5	3.9	3.5	4.45	4.85	5.7	6.6	7.15	7.0	5.3	7.65	4.0	5.95
6	3.9	3.55	4.75	4.65	5.8	6.65	6.75	6.95	5.1	6.95	4.05	6.4
7	3.85	3.65	4.7	4.55	5.85	6.85	6.35	6.9	5.0	7.0	3.9	6.65
8	3.85	3.65	5.35	4.5	5.9	7.1	6.3	7.0	5.2	7.7	3.95	6.6
9	3.8	3.7	5.65	4.5	5.9	7.55	6.2	7.1	5.6	7.25	3.95	6.15
10	3.8	3.7	5.95	4.5	7.15	7.5	5.8	7.3	7.0	7.05	4.0	6.15
11	3.75	3.7	5.0	4.5	5.8	7.55	5.3	7.5	9.7	7.0	4.05	6.05
12	3.75	3.7	4.9	4.5	5.7	8.1	5.5	6.85	8.35	6.8	4.0	5.55
13	3.7	3.7	5.3	4.5	5.7	8.65	4.95	8.95	7.6	6.4	4.1	5.65
14	3.7	3.65	5.35	4.4	5.95	9.0	4.9	8.65	7.95	6.0	5.55	5.35
15	3.7	3.65	6.3	4.3	6.1	9.45	4.75	7.55	7.4	5.9	8.3	5.25
16	3.65	3.65	6.2	4.3	6.05	9.7	4.65	7.75	7.2	5.3	7.1	5.45
17	3.6	3.6	5.9	4.25	5.95	9.8	4.7	8.55	6.9	5.1	6.6	5.9
18	3.6	3.6	5.95	4.15	5.95	9.6	5.4	8.25	6.9	5.05	6.7	5.6
19	3.6	3.6	5.9	4.0	5.9	9.55	5.25	8.3	6.95	4.95	6.75	5.8
20	3.6	3.6	5.9	4.0	5.9	9.7	6.5	8.75	6.75	4.95	6.75	7.35
21	3.6	3.65	6.0	4.0	5.9	9.7	6.2	9.1	5.85	4.85	6.65	7.25
22	3.6	4.0	6.15	4.25	5.9	9.2	6.5	8.45	5.5	4.75	6.55	7.0
23	3.75	4.4	6.05	4.45	5.95	8.8	6.9	7.3	5.5	4.7	6.1	6.65
24	3.85	4.4	5.85	7.7	6.15	8.6	7.0	6.95	5.35	4.6	5.65	7.1
25	3.9	4.4	5.65	5.95	7.25	8.6	7.9	7.1	6.65	4.5	5.35	7.15
26	3.9	4.4	5.55	5.3	6.3	8.55	7.1	7.45	8.75	4.45	5.25	6.6
27	3.9	4.4	5.45	4.95	6.1	8.4	7.5	7.7	10.2	4.35	5.15	6.15
28	3.85	4.4	5.4	4.9	6.05	10.3	7.8	7.35	10.7	4.25	5.0	5.95
29	3.8	.....	5.35	5.0	6.1	21.1	8.5	6.9	8.7	4.2	4.95	5.75
30	3.75	.....	5.15	6.7	6.1	9.65	8.7	6.35	7.8	4.15	4.8	5.55
31	3.7	.....	5.05	.....	6.3	.....	8.5	6.1	.....	4.1	.....	5.4

Daily discharge, in second-feet, of Rio Grande below mouth of Devils River, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,730	2,220	3,240	10,900	6,230	8,040	29,140	13,470	7,060	10,[illegible]	3,320	[illegible]
2	2,590	2,140	3,340	8,200	5,530	8,970	29,140	12,700	6,460	12,700	3,280	[illegible]
3	2,550	2,060	3,370	5,400	5,360	8,250	26,140	12,700	6,460	18,450	3,330	[illegible]
4	a2,520	a2,030	3,330	4,630	5,270	8,280	11,890	11,920	6,050	15,920	3,190	[illegible]
5	2,520	2,000	3,360	4,290	a5,270	8,310	11,390	10,840	a5,650	a12,180	a2,950	8,670
6	2,520	2,030	3,740	a3,950	5,600	a8,430	a9,390	10,680	4,950	10,280	2,990	a10,[illegible]
7	2,480	2,030	a3,630	3,940	5,800	9,380	7,910	10,530	4,750	10,400	2,630	[illegible]
8	2,480	2,090	4,700	4,030	6,010	10,570	7,740	a10,830	5,150	12,380	a2,660	[illegible]
9	2,440	a2,120	5,300	4,220	a6,090	12,710	7,390	11,130	5,950	a11,030	2,720	[illegible]
10	a2,440	2,120	5,900	a4,400	9,010	a12,470	6,130	11,730	9,450	10,440	2,880	[illegible]
11	2,350	2,120	4,000	4,400	5,640	12,550	5,080	12,330	20,600	10,290	3,040	a[illegible]
12	2,350	2,120	3,870	4,400	5,390	13,500	a5,500	a10,790	a13,860	9,700	a3,010	[illegible]
13	a2,260	a2,120	4,380	4,400	a5,390	14,460	4,350	17,150	11,400	a8,590	3,210	[illegible]
14	2,260	2,110	a4,500	a4,170	6,120	15,060	4,250	15,950	12,450	7,720	6,960	[illegible]
15	2,260	2,160	6,940	3,920	6,610	a15,960	3,940	12,770	10,800	7,510	a15,210	a[illegible]
16	2,220	2,210	6,870	3,920	6,600	18,140	3,730	13,330	10,200	6,200	11,340	[illegible]
17	2,190	a2,200	6,310	3,790	6,460	19,720	a3,840	a15,600	9,280	5,770	9,960	[illegible]
18	a2,190	2,200	a6,600	3,540	a6,570	20,100	5,530	14,770	a9,280	a5,670	10,180	[illegible]
19	2,160	2,200	6,480	a3,150	6,600	a21,080	5,170	14,910	9,430	5,230	10,290	[illegible]
20	2,130	2,200	6,480	3,150	6,600	22,100	8,180	16,350	8,960	4,980	a10,290	[illegible]
21	a2,100	2,240	6,720	3,150	a6,600	22,520	7,460	17,750	7,000	a4,530	10,070	[illegible]
22	2,100	a2,690	a7,080	a3,380	6,600	20,940	a8,180	15,330	6,240	4,360	9,860	[illegible]
23	2,250	3,490	6,520	3,650	6,700	a19,760	9,030	a12,100	6,240	4,290	8,900	[illegible]
24	2,350	3,490	5,720	10,000	7,110	18,330	9,240	11,420	a5,920	4,150	a7,800	a[illegible]
25	2,410	3,490	4,930	5,980	9,860	17,700	12,740	11,850	9,870	4,010	6,870	[illegible]
26	a2,410	3,490	a4,410	a4,800	a7,460	16,860	a9,550	a12,850	16,340	a3,940	6,560	[illegible]
27	2,410	3,490	4,240	4,310	6,960	a15,630	11,220	13,560	a21,000	3,790	6,250	a[illegible]
28	2,360	a3,490	4,160	4,240	6,840	25,100	12,460	12,560	23,500	3,620	5,790	[illegible]
29	2,310	.....	4,080	4,380	6,960	a80,350	15,380	11,280	16,020	3,540	a5,640	[illegible]
30	2,260	.....	3,750	a7,020	6,960	21,900	16,210	9,720	a13,140	3,450	5,290	[illegible]
31	a2,220	.....	a3,590	.....	a7,760	.....	a15,390	a9,000	.....	a3,370	.....	[illegible]

a Meter measurements.

Estimated monthly discharge of Rio Grande below mouth of Devils River, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	2,730	2,100	2,349	144,[illegible]
February	3,490	2,000	2,443	135,[illegible]
March	7,080	3,240	4,888	300,[illegible]
April	10,900	3,150	4,790	285,[illegible]
May	9,860	5,270	6,515	400,[illegible]
June	80,350	8,040	17,572	1,045,[illegible]
July	29,140	3,730	10,409	640,[illegible]
August	17,750	9,000	12,835	789,[illegible]
September	23,500	4,750	10,115	601,[illegible]
October	18,450	3,370	7,722	474,[illegible]
November	15,210	2,630	6,216	369,[illegible]
December	13,060	4,280	7,984	490,[illegible]
The year	80,350	2,000	7,820	5,67[illegible]

RIO GRANDE AT EAGLE PASS, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is a half mile above the highway bridge between Eagle Pass, Tex., and Ciudad Porfirio Diaz, Mexico, and about 540 miles below El Paso.

The river is practically straight for 1 mile above the station. Below it curves slowly to the right for about half a mile and then swings as slowly to the left. The right bank is alluvial deposit with a bottom back of it about 1,500 feet wide, which begins to overflow at gage height 22 feet. The left bank is shale rock rising abruptly from the river. The bed of the stream is shifting sand. At low water the depth is considerable and the velocity slow.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire. The initial point for soundings is the pole supporting the cable on the left bank.

The gage up to 10.5 feet is a vertical staff bolted to a shale cliff. Above 10.5 feet, it is inclined and spiked to posts set in the shale. The highest recorded flood reached gage height 34.6 feet, and occurred at midnight, June 29, 1905. The range between high and low water is 33 feet. The bench mark is the top of a nail driven into the shale at the gage; elevation, 10.40 feet above the datum of the gage.

The observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is J. K. Wilson, and the gage reader Robert Boubel.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, pp 365-366; 66, p 81; 84, p 158; 99, p 341; 132, p 88.
Discharge: WS 50, p 366; 66, pp 81-82; 84, pp 158-159; 99, pp 341-344; 132, pp 88-91.
Discharge, mean daily: WS 132, p 93.
Discharge, monthly: Ann 22, 1v, p 357; WS 75, p 162; 84, p 160; 99, p 345; 132, p 94.
Gage heights: WS 50, p 366; 66, p 82; 99, p 344; 132, p 92.
Hydrograph: WS 75, p 163.

Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	J. K. Wilson	2,609	1.68	3.3	4,373
January 7	do	2,557	1.58	3.1	4,048
January 11	do	2,464	1.31	3.1	3,221
January 14	do	2,498	1.26	3.1	3,158
January 17	do	2,464	1.37	3.0	3,370
January 21	do	2,479	1.38	2.8	3,416
January 24	do	2,467	1.32	2.8	3,259
January 28	do	2,473	1.40	2.95	3,462
January 31	do	2,542	1.33	3.1	3,390
February 3	do	2,530	1.28	3.0	3,229
February 7	do	2,472	1.27	2.7	3,131
February 11	do	2,444	1.41	2.9	3,452
February 14	do	2,499	1.30	2.8	3,254
February 17	do	2,450	1.32	2.8	3,239
February 21	do	2,484	1.29	2.8	3,213
February 24	do	2,529	1.59	3.25	4,024
February 28	do	2,551	1.62	3.2	4,126
March 4	do	2,548	1.63	3.2	4,143
March 6	do	2,657	1.69	3.4	4,498
March 9	do	2,947	2.42	4.1	7,126
March 10	do	3,729	4.25	5.4	15,851
March 14	do	2,931	2.53	4.0	7,406

Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
March 16	J. K. Wilson	3,600	4.15	5.1	14,945
March 19	do	2,965	3.00	4.6	8,902
March 23	do	2,982	3.09	4.7	9,226
March 27	do	2,893	2.37	4.15	6,850
March 31	do	2,823	2.38	4.0	6,715
April 1	do	3,695	3.66	5.5	13,534
April 2	do	4,270	6.34	6.75	27,061
April 6	do	2,955	1.96	3.8	5,792
April 10	do	2,611	1.99	3.6	5,207
April 13	do	2,576	2.04	3.7	5,250
April 17	do	2,535	1.98	3.5	5,010
April 20	do	2,483	1.80	3.35	4,478
April 24	do	3,817	4.82	6.4	18,395
April 27	do	2,622	2.43	4.0	6,370
April 30	do	2,974	2.79	4.25	8,298
May 4	do	2,827	2.99	4.4	8,447
May 8	do	2,791	2.93	4.5	8,188
May 11	do	2,767	2.85	4.5	7,895
May 15	do	3,119	3.20	4.9	9,994
May 18	do	2,758	3.02	4.4	8,341
May 21	do	3,038	3.26	4.5	9,905
May 25	do	3,109	3.66	5.05	11,370
May 28	do	3,062	3.97	5.25	12,150
May 31	do	3,093	3.74	4.8	11,580
June 3	do	3,116	3.40	5.1	10,593
June 7	do	3,389	3.36	5.05	11,395
June 10	do	3,573	4.48	5.95	16,014
June 13	do	3,727	4.95	6.35	18,445
June 17	do	4,326	5.54	7.4	23,980
June 20	do	4,255	5.13	7.2	21,834
June 23	do	4,206	5.01	7.1	21,080
June 27	do	4,269	4.58	6.9	19,559
July 10	do	4,533	2.76	4.8	12,529
July 14	do	3,918	1.89	4.0	7,418
July 17	do	3,837	1.88	4.0	7,214
July 21	do	4,183	2.65	5.0	11,082
July 25	do	3,977	2.08	4.3	8,261
July 28	do	4,061	2.91	5.25	11,815
July 31	do	4,401	3.99	6.7	17,575
August 4	do	3,874	3.73	6.0	14,458
August 7	do	4,052	3.52	5.4	14,247
August 10	do	3,816	3.53	5.6	13,488
August 16	do	3,773	3.95	5.7	14,915
August 19	do	4,011	3.99	6.0	16,000
August 23	do	4,052	4.20	6.0	17,014
August 26	do	3,723	3.63	5.5	13,512
August 29	do	3,665	3.71	5.4	13,614
August 31	do	3,607	2.99	4.8	10,782
September 4	do	3,371	2.47	4.4	8,329
September 7	do	3,099	2.14	3.8	6,646
September 11	Pedro Rosales	3,916	3.89	5.9	15,228
September 14	do	3,663	3.92	5.7	14,344
September 19	do	3,671	3.45	5.55	12,683

Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
September 22	Pedro Rosales	3,251	2.77	4.55	9,008
September 25	do	2,904	2.75	4.0	7,991
September 28	do	4,610	6.69	7.85	30,834
September 29	do	4,980	6.97	8.3	34,695
October 2	do	3,490	4.16	5.9	14,515
October 5	do	4,009	4.53	6.35	18,172
October 9	J. K. Wilson	3,939	4.75	6.3	18,728
October 17	do	2,733	2.55	3.9	6,973
October 20	do	2,458	2.17	3.5	5,344
October 24	do	2,377	2.00	3.3	4,752
October 27	do	2,275	1.97	3.2	4,484
October 31	do	2,252	1.99	3.0	4,472
November 4	do	2,436	2.27	3.3	5,526
November 7	do	2,310	2.00	2.9	4,622
November 11	do	2,226	1.85	2.7	4,127
November 15	do	3,254	3.70	5.0	12,039
November 18	do	2,940	4.10	4.85	12,041
November 22	do	3,954	3.73	4.9	14,756
November 25	do	2,548	2.66	4.2	6,768
November 28	do	2,420	2.57	3.7	6,216
November 30	do	2,321	2.33	3.6	5,419
December 4	do	2,510	2.17	3.3	5,438
December 8	do	2,609	2.87	4.3	7,498
December 11	do	2,629	2.39	3.8	6,273
December 14	do	2,371	2.44	3.7	5,785
December 18	do	2,367	2.36	3.6	5,584
December 21	do	3,152	4.07	4.8	12,817
December 26	do	4,011	4.05	4.95	16,242
December 28	do	2,492	3.10	4.4	7,718
December 31	do	2,631	2.40	3.85	6,327

Daily gage height, in feet, of Rio Grande at Eagle Pass, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.0	3.2	5.8	4.65	5.0	14.0	6.45	4.45	5.8	3.0	3.5
2	3.3	3.0	3.2	7.1	4.5	5.05	13.0	6.05	4.25	5.9	3.0	3.4
3	3.3	3.0	3.1	4.65	4.4	5.1	11.0	6.0	4.4	6.3	3.35	3.3
4	3.2	2.8	3.2	4.0	4.35	5.0	10.2	5.95	4.35	6.8	3.3	3.35
5	3.2	2.8	3.4	3.8	4.5	4.9	6.9	5.6	4.0	6.2	3.15	3.5
6	3.1	2.75	3.4	3.8	4.6	4.95	6.3	5.45	3.9	5.5	2.95	4.6
7	3.1	2.7	3.5	3.8	4.45	5.1	6.2	5.35	3.75	5.3	2.85	4.45
8	3.1	2.7	3.95	3.8	4.5	5.3	6.15	5.4	3.75	5.85	2.85	4.3
9	3.1	2.9	4.05	3.7	4.6	5.8	5.95	5.45	4.15	6.3	2.8	4.2
10	3.1	2.9	5.45	3.6	5.4	6.0	4.85	5.65	4.45	5.7	2.7	3.85
11	3.1	2.9	4.8	3.8	4.6	5.85	4.55	5.55	5.9	5.1	2.7	3.8
12	3.1	2.9	4.2	3.85	4.4	5.95	4.4	5.4	7.2	4.8	2.85	3.75
13	3.1	2.9	4.0	3.7	4.3	6.35	4.15	5.7	5.65	4.55	2.9	3.8
14	3.1	2.8	4.0	3.7	4.4	6.7	3.95	6.5	5.8	4.45	3.75	3.7
15	3.0	2.8	4.2	3.6	4.9	6.95	3.75	6.25	5.95	4.25	4.55	3.6
16	3.0	2.8	5.5	3.55	4.7	7.2	3.55	5.7	5.45	4.1	5.4	3.6
17	3.0	2.8	4.6	3.5	4.4	7.4	4.0	5.9	5.25	3.85	4.95	3.6
18	2.9	2.8	4.6	3.4	4.4	7.4	4.0	6.25	5.3	3.65	4.75	3.55
19	2.9	2.8	4.6	3.3	4.3	7.4	3.95	6.0	5.65	3.6	4.95	3.45
20	2.8	2.8	4.5	3.3	4.55	7.2	4.8	6.15	5.4	3.55	4.95	4.6
21	2.8	2.8	4.65	3.35	4.5	7.45	5.0	6.65	4.85	3.7	4.85	4.85
22	2.8	2.8	4.7	3.55	4.7	7.2	4.7	7.0	4.55	3.5	4.9	4.8
23	2.8	3.0	4.65	3.5	4.65	7.1	5.3	5.95	4.3	3.4	4.65	4.7
24	2.8	3.15	4.5	5.35	5.15	7.0	4.5	5.5	4.2	3.35	4.35	4.65
25	2.75	3.4	4.4	4.8	5.65	7.0	4.9	5.35	4.0	3.3	4.15	5.3
26	2.7	3.4	4.3	4.55	6.9	6.95	6.7	5.55	5.95	3.2	4.0	4.95
27	2.7	3.3	4.15	4.0	5.35	6.9	5.85	5.8	7.15	3.2	3.75	4.65
28	2.95	3.2	4.2	4.4	5.6	6.45	5.25	5.75	7.8	3.15	3.7	4.35
29	3.2	.....	4.1	4.05	5.0	16.8	5.65	5.35	8.1	3.1	3.6	4.2
30	3.1	.....	4.05	4.65	4.8	25.4	6.3	4.95	6.3	3.0	3.55	4.3
31	3.05	.....	4.0	.....	4.85	.....	6.7	4.75	.....	3.05	.....	3.85

Daily discharge, in second-feet, of Rio Grande at Eagle Pass, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,290	3,230	4,130	a15,200	9,430	11,650	75,500	16,460	8,640	14,010	4,470	5,350
2	4,330	3,230	4,130	a29,100	8,850	11,120	66,500	14,680	7,880	a14,510	4,470	5,280
3	a4,370	a3,230	3,950	9,000	8,450	a10,590	50,500	14,460	8,330	16,980	5,700	5,210
4	4,210	3,160	a4,140	6,390	a8,250	10,440	44,900	a14,210	a8,190	19,950	a5,530	a5,540
5	4,210	3,160	4,500	5,790	8,690	10,290	25,100	13,390	7,210	a17,420	5,190	5,850
6	4,050	3,140	a4,500	a5,790	8,930	10,740	21,500	13,570	6,930	14,120	4,740	8,120
7	a4,050	a3,130	4,750	5,790	8,160	a11,650	20,900	a14,000	a6,510	13,320	a4,500	7,810
8	3,840	3,130	6,530	5,790	a8,190	12,680	20,600	13,660	6,510	16,270	4,500	a7,500
9	3,630	3,450	a6,930	5,500	8,490	15,240	19,400	13,330	8,080	a18,730	4,370	7,250
10	3,420	3,450	a16,050	a5,240	12,500	a16,320	a12,830	a13,740	9,310	15,790	4,130	6,390
11	a3,220	a3,450	10,400	5,600	a8,300	15,410	10,930	13,390	a15,230	12,850	a4,130	a6,270
12	3,200	3,450	8,000	5,700	7,500	16,010	9,970	12,800	21,700	11,380	4,500	6,080
13	3,180	3,450	7,400	a5,250	7,100	a18,450	8,370	14,450	14,120	10,160	4,620	6,080
14	a3,160	a3,250	a7,400	5,250	7,500	20,300	a7,170	18,610	a14,840	9,670	7,170	a5,790
15	3,160	3,250	8,000	5,130	a9,990	21,620	6,480	17,510	15,400	8,690	a10,240	5,590
16	3,260	3,240	a16,550	5,070	9,330	22,930	5,710	a14,910	12,720	7,950	13,840	5,590
17	a3,370	a3,240	8,900	a5,010	8,340	a23,980	a7,210	15,640	11,540	a6,770	12,240	5,580
18	3,330	3,240	8,900	4,650	a8,340	23,980	7,210	17,250	11,610	5,960	a11,640	a5,480
19	3,390	3,230	a8,900	4,300	8,330	23,980	7,050	a16,000	a12,180	5,750	13,070	5,280
20	3,350	3,220	8,580	a4,300	9,720	a21,830	10,300	17,000	12,130	a5,550	13,700	11,610
21	a3,420	a3,210	9,070	4,480	a9,900	23,690	a11,080	19,750	10,110	6,140	13,930	a13,020
22	3,360	3,210	9,230	5,280	10,440	21,830	9,870	21,750	a9,010	5,340	a14,760	12,820
23	3,310	3,570	a9,010	5,080	10,310	a21,090	12,280	a16,660	8,550	5,050	12,130	12,420
24	a3,260	a3,840	8,360	a12,100	11,770	20,320	9,060	13,510	8,370	a4,900	9,100	12,220
25	3,210	4,320	7,930	9,570	a14,500	20,320	a10,500	12,760	a7,990	4,750	a6,720	17,300
26	3,160	4,320	7,500	8,570	20,900	19,940	17,600	a13,760	15,500	4,480	6,550	a16,240
27	3,160	4,220	a6,850	a6,370	12,900	a19,540	14,200	15,210	25,100	a4,480	6,280	11,590
28	a3,460	a4,130	6,970	7,970	a14,000	17,300	a11,810	15,160	a30,400	4,480	a6,220	a7,600
29	3,460	.....	6,840	6,570	11,830	166,600	13,400	a13,380	a33,000	4,480	5,670	7,220
30	3,470	.....	6,780	a9,900	11,580	238,300	15,980	11,480	17,200	4,350	a5,270	7,470
31	a3,340	.....	a6,720	.....	a11,780	.....	a17,580	a10,540	.....	a4,600	.....	a6,330

a Meter measurements.

Estimated monthly discharge of Rio Grande at Eagle Pass, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	4,370	3,160	3,542	217,805
February	4,320	3,130	3,434	190,711
March	16,550	3,950	7,674	471,868
April	29,100	4,300	7,324	435,788
May	20,900	7,100	10,139	623,445
June	238,300	10,290	29,939	1,781,474
July	75,500	5,710	18,757	1,153,309
August	21,750	10,540	14,936	918,387
September	33,000	6,510	12,810	762,228
October	19,950	4,350	9,641	592,820
November	14,760	4,130	7,646	454,968
December	17,300	5,210	8,125	499,597
The year	238,300	3,130	11,164	8,102,400

RIO GRANDE NEAR LAREDO, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It was intended to measure the river from the highway bridge connecting Laredo with Nuevo Laredo, Tamaulipas, and the gage was established on the right bank just above the bridge. Measurements were kept up by the Mexican section of the Commission for five months, but the results were so conflicting that the station was abandoned. In July, 1903, a cable station was established by the Commission some 2 miles above Nuevo Laredo, crossing to the United States military reservation of Fort McIntosh, the cable landing just below the pump house. The station is about 670 miles below El Paso.

The river at the new section is nearly straight for one-half mile above and below the cable. The right bank is alluvial deposit, but is above high water. The left bank is the talus of a shale bluff going well above high water. The bed is shifting sand.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support on the right bank.

The gage is an inclined scantling fastened to posts and trees. Low water is about 1 foot on the gage. The highest flood recorded is 32.2 feet, on the night of June 30, 1905.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

Discharge measurements of Rio Grande near Laredo, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 1	Luis Varela	2,183	1.84	2.3	4,023
January 5	do	2,015	1.71	2.2	3,453
January 10	do	1,978	1.69	2.2	3,339
January 17	do	1,940	1.60	1.8	3,096
January 21	do	1,942	1.56	1.7	3,036
January 24	do	1,977	1.59	1.65	3,140
January 28	do	1,946	1.52	1.6	2,956
February 5	do	1,958	1.56	1.6	3,064
February 11	do	1,831	1.53	1.5	2,797
February 15	do	1,826	1.56	1.5	2,851
February 18	do	1,840	1.60	1.5	2,944
February 23	do	1,827	1.57	1.5	2,876
February 27	do	1,857	1.58	1.5	2,927
March 1	do	1,815	1.58	1.5	2,870
March 6	do	2,010	1.69	2.2	3,404
March 10	do	2,231	2.32	3.1	5,169
March 15	do	2,250	2.18	3.2	4,909
March 17	do	3,054	3.81	4.95	11,642
March 24	do	3,550	3.72	3.9	9,480
March 28	do	2,190	2.23	3.0	4,889
May 1 [a]	do	2,288	2.33	3.2	5,329
May 7	do	2,343	2.16	3.3	5,066
May 13	do	2,472	2.25	3.5	5,551
May 19	do	2,330	2.24	3.6	5,208
May 21	do	2,461	1.79	3.0	4,416
May 24	do	2,420	2.28	3.3	5,516
May 25 [b]	do	2,521	2.40	4.2	6,049
May 27	do	3,800	4.54	7.55	17,256
June 10	do	2,806	4.86	5.8	13,646
June 12	do	2,785	3.85	5.0	10,710
June 14	do	2,677	5.18	6.0	13,867

[a] The record of measurements made during April was lost in a cyclone which occurred April 28.
[b] Gage height uncertain.

Discharge measurements of Rio Grande near Laredo, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
June 18	Luis Varela	2,852	5.18	7.0	14,760
June 23	do	3,229	5.39	7.75	17,407
June 25	do	2,701	5.19	6.6	14,005
July 2	do	5,370	5.73	12.2	30,749
July 3	do	4,944	5.67	11.9	28,044
July 13	do	2,622	3.19	6.3	8,369
July 16	do	2,554	2.59	5.8	6,603
July 23	do	2,358	2.56	5.5	6,025
July 26	do	2,322	2.48	5.4	5,751
July 27	do	2,664	3.70	7.2	9,854
August 8	do	2,538	2.53	5.0	6,426
August 11	do	3,787	5.70	8.2	21,602
August 15	do	3,809	3.23	6.45	12,318
August 16	do	3,648	3.86	6.6	14,091
August 21	do	3,647	3.29	5.4	11,993
August 27	do	3,179	3.74	6.2	11,893
August 29	do	3,490	3.66	6.5	12,777
September 2	do	3,017	2.94	5.1	8,867
September 7	do	3,212	2.69	4.2	8,627
September 13	do	4,723	4.96	8.35	23,416
September 16	do	4,314	3.76	7.0	16,227
September 22	do	3,102	3.31	5.8	10,256
September 27	do	3,315	3.61	6.55	11,981
September 29	do	4,634	5.02	9.9	23,270
October 4	do	3,321	4.82	7.0	15,998
October 10	do	3,410	5.14	7.25	17,534
October 17	do	2,514	2.97	4.85	7,456
October 18	do	2,456	2.89	4.8	7,101
October 26	do	2,302	2.42	4.3	5,574
October 30	do	2,247	2.06	3.9	4,627
November 3	do	2,104	2.11	3.8	4,438
November 12	do	2,028	1.81	3.1	3,671
November 15	do	2,135	2.23	3.9	4,760
November 17	do	3,012	4.60	6.65	13,855
November 24	do	2,620	3.75	5.5	9,823
November 30	do	2,247	2.32	4.4	5,221
December 3	do	2,145	2.42	4,3	5,201
December 8	do	2,709	2.51	5.3	6,807
December 14	do	2,439	2.80	4.7	6,823
December 16	do	2,239	2.48	4.5	5,549
December 22	do	2,941	3.34	5.8	9,812
December 26	do	2,816	4.19	6.2	11,793

Daily gage height, in feet, of Rio Grande near Laredo, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	1.6	1.5	2.9	3.55	4.5	18.6	7.25	5.6	7.2	3.9	4.45
2	2.3	1.6	1.6	4.25	3.6	4.15	11.2	7.05	5.15	6.65	3.95	4.45
3	2.25	1.6	1.7	6.65	3.75	4.2	10.5	7.05	4.8	6.5	3.7	4.25
4	2.2	1.6	1.75	3.2	3.55	4.2	9.8	7.15	4.4	7.4	4.2	4.25
5	2.15	1.65	1.9	3.2	3.5	4.45	9.3	6.85	4.65	8.2	4.05	5.3
6	2.0	1.7	2.2	3.0	3.35	4.5	8.1	6.45	4.8	6.8	3.9	5.3
7	2.0	1.7	2.3	2.9	3.3	4.45	7.75	5.65	4.55	6.35	3.85	5.35
8	2.05	1.7	2.45	2.9	3.65	3.75	7.5	5.1	4.6	6.15	3.6	5.45
9	2.2	1.7	2.5	2.8	3.55	4.25	7.25	7.05	4.7	6.55	3.35	5.3
10	2.2	1.6	2.8	2.6	3.7	5.2	7.05	7.0	4.55	7.15	3.55	5.3
11	2.15	1.5	4.1	3.15	3.85	5.0	6.8	8.25	5.1	6.9	3.5	5.35
12	2.0	1.5	3.3	2.9	3.85	5.0	6.3	7.5	6.9	5.95	3.05	4.45
13	1.9	1.5	3.3	2.8	3.55	5.05	6.25	6.85	7.9	5.55	3.25	4.9
14	1.9	1.5	3.25	2.6	4.1	6.0	6.05	6.7	7.25	5.35	4.0	4.75
15	1.9	1.5	3.2	2.6	5.1	6.1	5.95	7.15	7.25	5.2	3.95	4.7
16	1.85	1.5	4.45	2.5	4.1	6.7	5.75	6.8	7.0	5.0	5.15	4.65
17	1.8	1.5	4.65	2.45	3.65	7.3	5.6	6.8	6.65	4.9	6.8	4.6
18	1.8	1.5	3.65	2.4	3.7	7.0	5.55	7.2	6.2	4.75	6.2	4.55
19	1.8	1.5	3.0	2.3	3.45	7.45	5.6	7.15	6.1	4.55	6.35	4.4
20	1.7	1.5	3.5	2.25	3.05	7.45	5.4	6.25	6.65	4.55	5.9	4.4
21	1.7	1.5	3.7	2.25	3.15	6.95	5.0	5.6	6.35	4.6	6.0	4.4
22	1.7	1.5	3.7	2.45	5.0	7.7	5.3	6.1	5.6	4.4	5.85	5.8
23	1.6	1.5	3.85	2.95	3.75	7.25	5.55	5.55	5.1	4.4	5.45	5.85
24	1.6	1.5	3.85	2.9	3.85	7.4	5.85	5.25	5.0	4.5	5.45	6.15
25	1.6	1.5	3.5	4.25	4.5	6.55	5.95	5.2	4.75	4.45	5.1	6.0
26	1.6	1.5	3.5	4.1	5.6	6.55	6.1	5.1	4.85	4.25	4.9	6.3
27	1.6	1.5	3.35	3.55	7.1	6.7	7.2	6.1	6.6	4.1	4.7	5.7
28	1.6	1.5	3.1	3.2	6.1	6.55	7.4	6.15	9.2	3.9	4.65	5.0
29	1.6	.....	3.0	3.05	5.65	6.35	7.55	6.45	9.55	3.95	4.55	4.8
30	1.6	.....	3.0	3.35	4.3	23.0	7.55	5.45	8.75	3.85	4.45	4.6
31	1.6	.....	2.95	.....	4.0	.....	7.8	5.3	.....	3.95	.....	4.35

RIO GRANDE NEAR ROMA, TEX.

This station was established in 1900 by the International (Water) Boundary Commission. It is near Roma, Tex., 775 miles by river below El Paso.

The river is straight for 1 mile above and one-half mile below the station. The right bank is alluvial deposit and overflows in high water for a width of 250 feet. The overflow section is thickly covered with mesquite brush. The left bank is of hard material and does not overflow. The bottom is shifting sand.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support on the left bank.

The gage is an inclined scantling spiked to posts and trees. Low water is 1 foot on gage, and the highest recorded flood, September 16, 1904, marked 26.0 feet on gage.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

Discharge measurements of Rio Grande near Roma, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	H. P. Guerra	3,026	2.13	3.8	6,452
January 6	do	2,811	2.01	3.5	5,644
January 14	do	2,042	2.05	3.1	4,193
January 17	do	1,815	2.06	2.9	3,740
January 20	do	1,854	2.14	3.0	3,959
January 24	do	1,704	2.07	2.8	3,532
January 27	do	1,693	1.93	2.7	3,262
February 8	do	1,644	1.88	2.5	3,089
February 11	do	1,684	1.90	2.6	3,205
February 14	do	1,653	2.12	2.6	3,512
February 17	do	1,690	1.83	2.5	3,100
February 20	do	1,758	2.07	2.7	3,642
February 23	do	1,590	2.05	2.5	3,257
March 3	do	1,912	2.23	3.2	4,263
March 6	do	2,332	2.44	4.0	5,689
March 7	do	3,683	4.24	7.05	15,600
March 13	do	2,277	3.39	4.5	7,716
March 17	do	2,748	4.49	5.4	12,331
March 23	do	2,324	3.47	4.6	8,066
April 4	do	3,251	4.40	6.7	14,303
April 7	do	2,040	3.34	4.1	6,811
April 11	do	1,929	2.73	3.8	5,260
April 18	do	2,009	2.87	3.9	5,760
April 24	do	2,242	3.07	4.4	6,876
April 26	do	2,801	4.43	5.6	12,422
April 27	do	2,487	3.62	4.8	8,991
May 2	do	2,467	3.05	4.6	7,528
May 9	do	2,575	3.05	5.0	7,858
May 12	do	3,097	4.11	6.1	12,740
May 16	do	2,786	3.87	5.6	10,770
May 23	do	2,736	3.88	5.55	10,628
May 26	do	3,606	4.80	7.4	17,312
May 31	do	3,385	4.56	6.9	15,450
June 2	do	3,584	4.64	7.3	16,624
June 6	do	2,836	3.72	5.6	10,546
June 13	do	3,290	3.74	6.2	12,308
June 16	do	3,645	4.25	6.9	15,481
June 19	do	4,033	4.66	7.8	18,803
June 22	do	4,252	4.93	8.3	20,966
June 27	do	4,557	5.26	9.0	23,973
July 3	do	8,374	5.14	17.0	43,041
July 5	do	5,682	5.22	11.5	29,642
July 7	do	4,368	5.17	8.7	22,568
July 10	do	3,923	3.67	7.3	14,387
July 14	do	4,004	2.82	6.1	11,289
July 17	do	3,850	2.74	5.7	10,531
July 20	do	3,685	2.61	5.3	9,633
August 8	do	3,155	3.94	6.2	12,437
August 11	do	3,299	4.13	6.6	13,641
August 15	do	4,058	4.38	7.7	17,767
August 17	do	3,796	3.76	7.2	14,267
August 22	do	3,433	4.05	6.9	13,912
August 24	do	4,143	4.61	7.9	19,116

Discharge measurements of Rio Grande near Roma, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
September 5	H. F. Guerra	2,902	3.11	5.2	9,0[illegible]6
September 8	do	2,751	3.01	4.9	8,277
September 13	do	4,083	4.60	7.8	18,7[illegible]0
September 19	do	6,224	5.38	12.7	33,[illegible]
September 21	do	4,933	4.82	9.7	23,7[illegible]
September 23	do	3,763	4.42	7.1	16,6[illegible]
September 29	do	4,246	4.59	8.1	19,4[illegible]
October 5	do	4,482	4.74	8.5	21,2[illegible]
October 7	do	3,816	4.42	7.2	16,8[illegible]
October 9	do	3,425	4.11	6.8	14,079
October 13	do	3,294	3.63	6.1	11,944
October 17	do	2,981	3.37	5.5	10,0[illegible]
October 20	do	2,836	2.60	5.1	7,5[illegible]
October 24	do	2,530	2.64	4.5	6,6[illegible]
November 7	do	2,334	2.52	4.4	5,8[illegible]
November 10	do	2,138	2.05	4.0	4,3[illegible]
November 17	do	3,031	4.07	6.0	12,[illegible]
November 20	do	3,294	4.01	6.6	13,[illegible]
November 25	do	2,814	3.51	5.5	9,8[illegible]
November 28	do	2,618	3.29	5.0	[illegible]
December 9	do	2,706	3.47	5.3	9,[illegible]
December 11	do	2,557	3.08	4.9	7,8[illegible]
December 14	do	2,358	3.19	4.7	7,[illegible]
December 20	do	2,244	3.13	4.4	7,0[illegible]
December 23	do	2,938	3.53	5.8	10,[illegible]
December 28	do	2,891	3.29	5.5	9,5[illegible]

Daily gage height, in feet, of Rio Grande near Roma, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.0	2.7	4.1	5.3	6.35	17.7	7.65	5.8	8.2	4.75	4.75
2	3.8	3.0	3.05	4.35	4.6	7.0	22.3	7.75	5.55	6.9	4.65	4.7
3	3.8	2.85	3.15	4.8	4.7	6.35	16.55	7.35	5.35	6.6	4.55	4.65
4	3.7	2.8	2.9	6.75	4.75	6.3	13.75	7.1	5.05	7.15	4.45	4.6
5	3.65	2.7	3.2	4.75	4.7	5.85	10.9	6.9	5.2	8.5	4.6	4.55
6	3.55	2.7	3.85	4.2	4.7	5.6	9.15	6.75	5.4	7.85	4.55	4.7
7	3.45	2.6	6.35	4.05	4.75	5.65	8.55	6.65	5.0	7.05	4.45	4.95
8	3.4	2.55	4.7	3.9	4.8	5.55	7.9	6.35	4.9	6.5	4.15	5.45
9	3.4	2.5	3.65	4.0	5.1	5.6	7.35	6.1	4.8	6.55	4.3	5.35
10	3.3	2.6	3.45	3.9	5.0	5.7	7.15	6.4	4.8	7.1	4.05	5.25
11	3.3	2.6	3.75	3.85	5.05	6.15	6.95	6.5	5.1	7.2	4.0	5.05
12	3.25	2.6	4.5	3.9	6.0	6.2	6.7	6.6	5.45	6.6	4.0	4.9
13	3.2	2.6	4.4	3.9	5.15	6.15	6.45	6.5	7.35	6.2	4.05	4.8
14	3.15	2.6	3.95	4.1	4.8	6.4	6.2	6.35	7.45	5.85	4.0	4.75
15	3.05	2.5	3.9	4.25	5.5	6.75	5.95	7.7	6.4	5.65	4.3	4.65
16	3.0	2.5	3.9	4.0	5.7	6.95	5.75	7.35	6.5	5.55	4.25	4.6
17	2.9	2.5	4.85	3.9	5.05	7.4	5.8	7.05	6.55	5.5	5.55	4.5
18	2.9	2.55	5.25	3.95	4.75	7.55	6.4	6.7	6.1	5.3	6.15	4.5
19	2.95	2.95	4.45	4.0	4.55	7.75	5.65	7.2	11.3	5.3	5.6	4.5
20	3.0	2.75	4.35	3.95	4.45	7.7	5.45	6.9	10.1	5.55	6.45	4.45
21	2.9	2.6	4.4	3.9	4.5	7.75	5.6	6.9	9.3	5.6	5.9	4.4
22	2.9	2.6	4.55	3.9	4.5	8.15	6.9	6.95	8.7	5.8	5.9	5.1
23	2.8	2.6	4.6	3.95	5.15	8.15	7.2	7.55	7.5	5.1	5.8	5.7
24	2.8	2.45	4.5	4.5	4.65	7.95	6.95	7.7	5.9	4.5	5.75	5.55
25	2.8	2.4	4.5	4.35	4.8	7.85	6.85	6.7	5.65	4.35	5.55	5.6
26	2.8	2.35	4.4	4.85	6.75	7.65	7.15	6.4	5.55	4.5	5.35	5.75
27	2.7	2.3	4.4	4.95	6.4	8.8	7.2	6.4	5.45	4.4	5.05	5.7
28	2.85	2.15	4.4	4.65	6.8	8.35	7.65	6.25	6.4	4.45	4.95	5.55
29	2.9	.....	4.3	5.1	6.55	8.0	6.9	6.75	8.3	4.3	4.85	5.4
30	3.0	.....	4.2	5.8	7.3	8.25	6.85	6.45	8.9	4.2	4.8	5.15
31	3.0	.....	4.2	.....	6.5	.....	6.95	6.2	.....	4.3	.....	5.0

RIO GRANDE NEAR BROWNSVILLE, TEX.

This station was established in 1900 by the International (Water) Boundary Commission. It is about 1 mile above Brownsville, Tex., and in front of Matamoros, Tamaulipas, and 960 miles by river below El Paso.

Between Roma and Brownsville there are many lagoons (old river beds) and lakes which take river water during moderate floods, and a large area overflows quite deeply in larger floods. Much of this water returns slowly to the river as the flood subsides, so that the flow passes Brownsville more uniformly than it does Roma. Large quantities of water also leave the river entirely, reaching the Gulf of Mexico through channels remote from the Rio Grande Local run-off, however, keeps the total water at Brownsville well up toward the combined flow of the San Juan and the Rio Grande at Roma. The river is nearly straight for one-half mile above and below the station. Both banks are alluvial and are just about level with high water. The right bank is protected by piling. The bed of the stream is shifting sand.

Discharge measurements are made by means of a cable, car, and guy wire. The cable is so constructed that it can be lowered and raised. The initial point for soundings is the cable support on the right bank.

The gage is a vertical scantling fastened to one of the protection piles. High water is 13 feet on the gage, and low water is —1.0.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

Discharge measurements of Rio Grande near Brownsville, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 2	P. Guerra	2,886	2.60	5.3	7,492
January 6	do	2,712	2.59	4.7	7,03[illegible]
January 10	do	2,588	2.41	4.3	6,23[illegible]
January 14	do	2,531	2.34	4.1	5,9[illegible]
January 18	do	2,381	2.33	3.8	5,54[illegible]
January 22	do	2,318	2.32	3.5	5,38[illegible]
January 26	do	2,301	2.30	3.4	5,29[illegible]
January 30	do	2,247	2.16	3.2	4,85[illegible]
February 3	do	2,252	2.24	3.4	5,03[illegible]
February 7	do	2,276	2.29	3.5	5,20[illegible]
February 11	do	2,138	2.20	3.0	4,71[illegible]
February 16	do	2,112	2.17	2.9	4,58[illegible]
February 24	do	2,230	2.22	3.1	4,95[illegible]
February 27	do	2,122	2.17	2.8	4,56[illegible]
March 3	do	2,172	2.21	2.9	4,79[illegible]
March 7	do	2,283	2.30	3.5	5,25[illegible]
March 13	do	2,321	3.30	5.2	7,65[illegible]
March 17	do	2,468	3.41	5.7	8,41[illegible]
March 20	do	3,141	3.36	7.6	10,54[illegible]
March 25	do	2,926	3.44	6.5	10,06[illegible]
March 29	do	2,964	3.43	6.5	10,16[illegible]
April 2	do	2,734	3.31	5.8	9,04[illegible]
April 6	do	4,010	4.55	9.25	18,25[illegible]
April 11	do	2,835	2.19	5.1	6,20[illegible]
April 16	do	2,735	2.19	4.9	6,00[illegible]
April 24	do	2,535	2.03	4.0	5,13[illegible]
April 28	do	3,528	3.22	6.8	11,3[illegible]
May 2	do	3,117	3.49	7.65	10,8[illegible]
May 6	do	2,635	3.33	6.3	8,77[illegible]
May 10	do	2,524	3.18	6.0	8,02[illegible]
May 14	do	3,086	3.44	7.5	10,62[illegible]
May 18	do	4,015	3.27	7.9	13,1[illegible]
May 22	do	2,566	3.35	6.1	8,5[illegible]
May 26	do	3,575	3.12	6.8	11,1[illegible]
May 30	do	4,980	4.67	10.5	23,2[illegible]
June 3	do	5,282	4.60	11.2	24,2[illegible]
June 6	do	5,136	4.03	10.8	20,7[illegible]
June 11	do	4,268	3.65	8.4	15,5[illegible]
June 15	do	4,508	3.72	9.0	16,7[illegible]
June 20	do	5,516	4.42	11.7	24,[illegible]
June 24	do	5,967	4.78	12.7	28,[illegible]
June 28	do	5,716	4.63	12.2	28,4[illegible]
July 2	do	6,103	4.60	13.1	2[illegible]
July 6	do	6,274	4.65	13.5	29,1[illegible]
July 10	do	6,105	4.11	13.3	25,0[illegible]
July 12	do	5,148	3.64	11.0	18,7[illegible]
July 18	do	4,290	2.79	8.8	11,9[illegible]
July 22	do	4,521	3.20	9.5	14,4[illegible]
July 26	do	4,071	3.50	9.3	14,2[illegible]

Discharge measurements of Rio Grande near Brownsville, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
July 30	P. Guerra	4,899	3.73	11.65	18,275
August 3	do	4,806	4.42	11.3	21,236
August 7	do	4,561	4.03	10.5	18,382
August 11	do	4,038	3.64	9.4	14,697
August 15	do	4,118	3.68	9.6	15,135
August 19	do	4,621	3.99	10.6	18,435
August 24	do	4,723	4.11	10.8	19,390
August 28	do	4,008	3.59	9.25	14,399
September 1	do	4,756	3.32	9.6	15,773
September 6	do	4,169	2.39	7.5	9,946
September 10	do	4,039	2.21	7.1	8,937
September 14	do	4,091	2.27	7.3	9,301
September 18	do	4,899	3.32	9.8	16,287
September 21	do	6,069	4.77	12.8	28,944
September 25	do	6,202	5.00	13.1	31,029
September 29	do	3,448	2.97	8.1	10,259
October 3	do	5,260	4.39	12.8	23,081
October 7	do	5,407	4.95	13.1	26,749
October 11	do	4,714	3.55	11.3	16,714
October 15	do	5,127	3.14	10.7	16,121
October 20	do	4,416	2.30	8.1	10,171
October 24	do	4,582	2.50	8.5	11,476
October 29	do	3,627	1.88	6.5	6,802
November 2	do	3,622	2.03	6.1	7,338
November 6	do	3,407	3.22	7.9	10,956
November 8	do	3,462	3.38	8.1	11,697
November 14	do	3,827	2.15	6.7	8,237
November 18	do	3,630	2.16	6.5	7,833
November 22	do	4,972	4.02	10.1	20,002
November 26	do	3,607	3.74	8.7	13,500
November 29	do	3,272	3.37	7.9	11,011
December 3	do	3,724	2.41	6.6	8,970
December 8	do	3,453	2.21	6.3	7,638
December 12	do	3,216	3.27	7.8	10,506
December 17	do	3,813	2.46	6.9	9,394
December 21	do	3,596	2.16	6.3	7,767
December 25	do	3,460	3.32	8.0	11,487
December 29	do	4,025	3.56	8.6	14,349

Daily gage height, in feet, of Rio Grande near Brownsville, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.45	3.2	2.7	6.1	7.4	11.05	12.7	10.7	9.5	12.75	6.2	7.05
2	5.35	3.4	2.7	5.75	7.5	10.35	13.0	10.9	8.9	13.1	6.1	6.85
3	5.15	3.4	2.9	5.55	6.3	11.8	13.1	11.3	8.4	12.95	6.65	6.65
4	4.95	3.4	3.15	5.65	6.05	12.5	13.15	11.55	8.0	11.45	11.55	6.55
5	4.85	3.45	3.35	9.0	6.15	11.7	13.4	11.1	7.7	10.85	10.1	6.45
6	4.65	3.6	3.4	9.25	6.3	11.05	13.5	10.65	7.45	12.65	8.05	6.3
7	4.6	3.45	3.45	6.75	6.3	9.7	13.5	10.45	7.2	13.1	7.4	6.3
8	4.5	3.25	5.85	5.6	6.2	8.8	13.5	10.25	7.35	13.05	8.1	6.3
9	4.35	3.1	7.7	5.3	6.05	8.55	13.5	9.9	7.35	13.0	8.35	6.9
10	4.25	3.05	7.7	5.2	6.1	8.45	12.95	9.6	7.15	12.25	7.9	7.7
11	4.25	2.95	6.0	5.15	6.45	8.4	11.65	9.4	6.95	11.25	7.45	8.0
12	4.15	2.9	5.05	5.1	6.6	8.55	10.9	9.55	6.75	11.65	7.25	7.7
13	4.25	2.9	5.1	5.0	6.5	8.9	10.6	9.65	6.75	11.55	6.95	7.35
14	4.1	2.9	6.1	5.0	7.35	9.0	10.3	9.75	7.5	11.1	6.75	7.2
15	4.0	2.9	6.1	4.95	7.5	9.05	9.7	9.5	11.0	10.5	6.55	7.1
16	3.95	2.9	5.85	4.9	6.85	9.35	9.15	9.15	10.95	9.7	6.4	7.05
17	3.9	2.9	5.7	4.8	7.7	10.15	8.95	9.9	9.8	9.0	6.4	6.9
18	3.8	2.9	5.7	4.75	7.75	10.7	8.75	10.95	9.75	8.65	6.5	6.8
19	3.8	2.9	6.95	4.65	6.6	11.35	10.45	10.5	9.55	8.4	8.95	6.65
20	3.7	2.9	7.55	4.45	6.1	11.75	12.4	10.4	9.75	8.15	9.7	6.45
21	3.6	2.9	6.6	4.4	6.1	12.0	10.8	10.75	12.85	8.15	9.3	6.3
22	3.5	3.0	6.15	4.25	6.1	12.05	9.05	10.5	13.05	8.95	10.15	6.15
23	3.5	3.1	6.1	4.1	6.1	12.5	8.3	10.3	13.25	8.5	10.15	6.55
24	3.5	3.1	6.35	4.05	6.1	12.7	9.2	10.7	13.4	8.5	9.4	7.8
25	3.5	2.9	6.5	3.85	6.75	12.65	9.6	11.5	12.25	8.35	9.1	8.0
26	3.4	2.9	6.65	3.8	6.8	12.3	9.3	11.65	9.75	7.6	8.8	7.9
27	3.3	2.8	6.7	4.6	6.95	12.05	9.8	9.65	8.75	6.9	8.45	7.8
28	3.2	2.8	6.65	6.55	9.4	12.3	10.4	9.15	8.35	6.65	8.05	8.5
29	3.2	.....	6.5	6.55	9.75	12.75	11.7	8.6	8.1	6.45	7.75	8.55
30	3.2	.....	6.35	6.1	10.4	12.8	11.4	9.2	8.0	6.35	7.3	8.2
31	3.2	.....	6.15	.....	10.6	.....	10.9	9.7	.....	6.25	.....	7.6

RIO SALADO NEAR GUERRERO, TAMAULIPAS, MEXICO.

This station was established in 1900 by the International (Water) Boundary Commission. The Salado is a torrential stream entering the Rio Grande from the Mexican side about 60 miles below Laredo, or 730 miles by river below El Paso. The town of Guerrero is located on the Salado some 4 miles above its mouth, and the gaging station is 2 miles above the town.

The river is a series of pools and rapids. The best pool available was chosen for the station. The river curves to the left both above and below the cable. The banks are sandy clay, not subject to erosion. The bottom is mud. In low water the river is measured by wading among rocks below the station.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support on the left bank.

The gage is an inclined scantling fastened to posts sunk in the bank. Low water (no flow) is −1 on the gage. The highest recorded flood, on June 16, 1903, gave 17.7 on gage.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	D. de Lasseaulx	1,789	0.51	3.6	916
January 7	do	1,766	.49	3.5	871
January 11	do	1,747	.46	3.4	795
January 15	do	1,726	.42	3.3	727
January 19	do	1,481	.43	3.2	638
January 23	do	1,687	.36	3.1	609
January 28	do	1,665	.34	3.0	560
February 1	do	1,650	.29	2.9	485
February 5	do	1,628	.26	2.8	431
February 9	do	1,610	.25	2.7	404
February 13	do	1,615	.25	2.6	405
February 17	do	1,586	.25	2.5	397
February 21	do	1,585	.25	2.5	395
February 25	do	1,565	.24	2.4	369
March 1	do	1,556	.23	2.3	352
March 5	do	1,631	.26	2.7	419
March 7	do	2,050	1.01	4.8	2,067
March 11	do	1,890	.76	4.0	1,441
March 18	do	1,729	.40	3.3	683
March 24	do	1,685	.32	3.0	539
March 28	do	1,624	.27	2.8	435
April 1	do	1,601	.27	2.7	428
April 5	do	1,583	.26	2.6	415
April 10	do	1,560	.26	2.4	401
April 14	do	1,531	.24	2.3	366
April 18	do	1,510	.23	2.2	350
April 22	do	1,492	.18	2.1	265
April 26	do	1,489	.17	2.0	249
May 2	do	1,632	.32	2.9	518
May 6	do	1,471	.18	2.1	268
May 10	do	1,411	.16	1.7	219
May 12	do	1,707	.38	3.3	656
May 17	do	1,482	.18	2.1	266
May 21	do	1,452	.16	1.9	239
May 26	do	2,421	2.26	6.75	5,479
May 30	do	2,520	2.46	7.2	6,194
June 3	do	1,698	.89	4.0	1,506
June 7	do	1,580	.49	3.4	773
June 11	do	1,475	.42	3.0	624
June 15	do	1,446	.29	2.7	423
June 20	do	1,366	.25	2.3	337
June 24	do	1,416	.31	2.8	436
June 28	do	2,076	1.86	6.0	3,861
July 3	do	2,384	3.03	8.2	7,218
July 7	do	1,762	1.43	5.2	2,523
July 12	do	1,774	1.29	4.9	2,282
July 16	do	1,708	1.23	4.7	2,095
July 20	do	1,695	1.34	5.0	2,275
July 23	do	1,784	1.67	5.5	2,984
July 27	do	1,716	1.41	5.1	2,423
August 1	do	1,681	1.19	4.9	1,992
August 5	do	1,599	1.07	4.6	1,718
August 9	do	1,559	.98	4.4	1,530

Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1905—Cont'd.

Date.	Hydrographer,	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
August 13	D. de Lassaulx	1,535	0.90	4.3	1,382
August 18	do	1,488	.83	4.0	1,236
August 23	do	1,469	.74	3.8	1,082
August 28	do	1,427	.71	3.7	1,007
September 2	do	1,405	.66	3.6	933
September 7	do	1,405	.62	3.5	870
September 15	do	1,371	.57	3.4	783
September 20	do	1,973	2.43	6.4	4,798
September 22	do	2,618	3.82	9.3	10,003
September 25	do	1,427	.83	3.8	1,182
September 29	do	1,368	.65	3.5	883
October 4	do	2,031	2.61	7.0	5,291
October 8	do	1,389	.77	3.8	1,069
October 12	do	1,354	.69	3.6	935
October 16	do	1,296	.61	3.3	791
October 21	do	1,907	2.23	6.4	4,251
October 26	do	1,260	.52	3.1	660
October 29	do	1,243	.50	3.0	616
November 2	do	1,460	.93	4.0	1,361
November 6	do	1,246	.45	3.0	558
November 10	do	1,225	.42	2.9	509
November 14	do	1,202	.40	2.8	478
November 18	do	1,207	.39	2.8	476
November 22	do	1,280	.48	3.2	611
November 27	do	1,208	.38	2.8	464
December 1	do	1,172	.38	2.7	445
December 6	do	1,223	.41	2.9	505
December 10	do	1,152	.37	2.6	422
December 15	do	1,152	.37	2.6	422
December 19	do	1,220	.41	2.9	505
December 23	do	1,193	.36	2.7	435
December 28	do	1,164	.36	2.6	418

Daily gage height, in feet, of Rio Salado near Guerrero, Tamaulipas, Mexico, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	2.9	2.3	2.7	2.7	4.8	3.95	4.85	3.55	3.5	4.05	2.7
2	3.6	2.9	2.3	2.7	2.85	4.7	6.9	4.8	3.55	3.4	4.0	2.7
3	3.6	2.9	2.3	2.6	2.45	5.2	8.35	4.75	3.5	3.4	3.6	2.7
4	3.5	2.8	2.45	2.6	2.25	5.4	9.4	4.7	3.5	7.1	3.2	2.7
5	3.5	2.8	2.7	2.6	2.15	4.1	5.9	4.6	3.55	5.9	3.0	2.6
6	3.5	2.8	4.55	2.6	2.05	3.7	5.45	4.6	3.6	4.65	3.0	2.85
7	3.5	2.7	4.75	2.5	2.0	4.0	5.2	4.5	3.5	4.0	3.0	2.75
8	3.5	2.7	4.1	2.5	2.1	4.0	5.15	4.5	3.5	3.8	2.9	2.7
9	3.5	2.7	3.2	2.5	1.8	3.4	5.15	4.5	3.5	3.75	2.9	2.65
10	3.5	2.7	3.8	2.4	2.5	3.25	5.05	4.4	3.4	3.65	2.9	2.6
11	3.4	2.7	3.85	2.4	3.4	3.0	5.0	4.45	3.4	3.5	2.8	2.6
12	3.4	2.7	3.25	2.4	3.15	3.0	4.9	4.3	3.4	3.8	2.85	2.65
13	3.4	2.6	3.0	2.4	2.8	2.9	4.9	4.3	3.4	3.55	2.85	2.7
14	3.3	2.6	3.0	2.3	3.0	2.8	4.8	4.2	3.4	3.4	2.8	2.7
15	3.3	2.6	2.9	2.3	2.55	2.7	4.8	4.15	3.4	3.3	2.8	2.6
16	3.3	2.5	2.9	2.3	2.4	2.6	4.7	4.1	3.4	3.3	2.8	2.6
17	3.3	2.5	3.15	2.2	2.1	2.5	5.9	4.1	3.3	3.3	2.8	2.6
18	3.3	2.5	3.3	2.2	2.2	2.4	4.85	4.0	3.3	3.2	2.8	2.65
19	3.2	2.75	3.25	2.2	2.2	2.35	5.4	4.0	4.7	3.2	4.3	2.85
20	3.2	2.55	3.15	2.2	1.9	2.3	4.9	3.95	6.7	3.6	4.6	2.85
21	3.2	2.5	3.5	2.1	1.85	3.05	5.7	3.9	7.75	6.2	3.15	2.85
22	3.2	2.5	3.85	2.1	1.8	3.2	5.75	3.9	9.3	6.2	3.3	2.95
23	3.2	2.5	3.3	2.1	1.7	2.95	5.45	3.8	4.95	4.05	3.05	2.85
24	3.1	2.5	3.05	2.1	1.7	2.7	5.35	3.8	4.25	3.45	2.95	2.7
25	3.1	2.4	3.0	2.1	3.9	2.5	5.25	3.8	3.85	3.3	2.9	2.7
26	3.1	2.4	3.0	2.0	7.1	2.35	5.2	3.7	3.75	3.1	2.85	2.6
27	3.0	2.4	2.9	2.0	4.3	3.6	5.1	3.7	3.65	3.1	2.8	2.6
28	3.0	2.4	2.8	2.2	4.7	5.9	5.05	3.7	3.55	3.0	2.8	2.6
29	3.0	.....	2.8	2.3	5.7	4.8	5.0	3.65	3.5	3.0	2.8	2.6
30	3.0	.....	2.8	2.0	7.3	4.0	4.9	3.6	3.5	3.0	2.7	2.6
31	2.9	.....	2.8	.....	5.6	.....	4.9	3.6	.....	3.0	.....	2.5

RIO SAN JUAN NEAR SANTA ROSALIA RANCH, TAMAULIPAS, MEXICO.

This station was established in 1900 by the International (Water) Boundary Commission. The San Juan is a long torrential stream entering the Rio Grande 15 miles below Roma and 790 miles by river below El Paso. Six miles above its mouth is the town of Camargo. The station was first placed 12 miles above Camargo, but in time of heavy flood in the Rio Grande backwater reached the station, and on July 14, 1902, it was moved 6 miles farther upstream to its present location. It is now above backwater.

Both banks are sandy clay which are above high water and do not erode. The bottom is sand, which erodes slightly in flood.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support at the right bank.

The gage is an inclined scantling spiked to posts and a tree. Low water (no flow) is 0 on the gage. The highest recorded flood, on September 16, 1904, reached 27 feet on the gage.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 4	S. Jaso	666	0.31	2.5	209
January 9	do	659	.25	2.5	165
January 14	do	626	.26	2.3	160
January 18	do	621	.19	2.2	117
January 21	do	618	.18	2.2	113
January 26	do	600	.12	2.0	74
January 30	do	614	.13	2.0	81
February 4	do	591	.13	2.0	77
February 8	do	601	.14	1.95	82
February 12	do	543	.11	1.7	56
February 16	do	545	.10	1.7	54
February 20	do	583	.12	2.0	69
February 24	do	636	.17	2.3	109
February 28	do	587	.11	2.0	63
March 4	do	567	.10	1.9	57
March 6	do	817	.72	3.4	586
March 8	do	1,839	1.82	7.2	3,345
March 13	do	609	.29	2.2	176
March 17	do	658	.40	2.6	264
March 21	do	630	.36	2.5	227
March 25	do	596	.33	2.2	194
March 29	do	552	.20	1.9	113
April 3	do	614	.32	2.4	198
April 7	do	453	.12	1.4	53
April 12	do	486	.15	1.6	74
April 20	do	434	.12	1.25	52
April 24	do	748	.58	3.35	436
April 28	do	493	.10	1.4	49
May 3	do	414	.12	1.3	49
May 8	do	1,466	1.51	6.45	2,191
May 9	do	877	.89	3.95	778
May 12	do	448	.16	1.7	72
May 17	do	344	.09	1.1	30
May 22	do	308	.08	.9	25
May 26	do	310	.08	1.0	26
May 31	do	2,431	2.53	10.25	6,142
June 2	do	3,736	3.92	15.65	14,663
June 3	do	2,794	2.41	11.7	6,741
June 5	do	1,283	1.98	5.65	2,541
June 9	do	541	.66	3.2	355
June 13	do	389	.34	2.3	132
June 17	do	307	.21	1.75	66
June 22	do	970	1.34	4.1	1,296
June 27	do	359	.44	2.55	158
July 3	do	312	.22	1.8	69
July 7	do	256	.10	1.3	25
July 11	do	219	.07	1.0	16
July 15	do	202	.07	.9	15
July 16	do	491	.74	3.0	361
July 18	do	3,883	4.04	16.35	15,676
July 19	do	1,748	2.58	10.1	4,518
July 25	do	288	.44	2.3	127

Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
July 31	S. Jaso	190	0.14	1.5	27
August 4	do	167	.12	1.3	20
August 9	do	151	.08	1.1	12
August 11	do	371	.91	2.9	338
August 14	do	229	.29	1.8	66
August 18	do	153	.15	1.2	23
August 22	do	135	.08	.9	11
August 26	do	118	.08	.8	10
August 30	do	108	.06	.7	7
September 4	do	101	.06	.5	6
September 17	do	382	.90	2.8	345
September 19	do	626	2.16	4.85	1,354
September 20	do	3,955	4.57	16.5	18,071
September 21	do	2,521	3.35	13.15	8,444
September 25	do	653	1.77	5.05	1,155
September 29	do	231	.56	2.2	129
October 3	do	180	.30	1.7	54
October 4	do	1,485	2.68	6.55	3,973
October 7	do	2,620	3.52	13.65	9,230
October 8	do	1,761	3.28	10.2	5,781
October 9	do	1,386	2.35	8.0	3,262
October 11	do	605	1.45	4.7	875
October 13	do	1,481	2.63	8.6	3,899
October 16	do	580	1.30	4.5	756
October 21	do	470	.82	3.3	387
October 26	do	462	.82	3.2	378
November 3	do	2,170	3.77	14.7	8,179
November 6	do	1,661	3.39	11.2	5,625
November 9	do	1,614	2.54	8.75	4,102
November 13	do	1,083	1.92	6.6	2,077
November 18	do	954	1.87	5.9	1,786
November 21	do	1,844	2.41	10.75	4,445
November 27	do	917	1.42	4.9	1,305
December 3	do	960	1.15	4.4	1,104
December 9	do	1,050	1.72	5.45	1,801
December 14	do	709	1.40	4.3	990
December 18	do	712	1.23	4.2	875
December 22	do	638	1.14	3.9	727
December 27	do	600	.98	3.7	586
December 30	do	636	.76	3.6	485

Daily gage height, in feet, of Rio San Juan near Santa Rosalia Ranch, Tamaulipas, Mexico, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.0	2.0	1.7	1.4	7.4	2.05	1.5	0.6	1.95	4.75	4.6
2	2.6	3.25	2.0	1.7	1.35	14.1	1.95	1.4	.6	1.75	19.3	4.55
3	2.6	2.3	1.9	2.2	1.3	10.4	1.75	1.4	.6	3.5	14.45	4.4
4	2.5	2.0	1.9	1.7	1.3	10.55	1.6	1.3	.5	6.6	9.95	4.3
5	2.5	1.9	2.6	1.6	1.3	6.0	1.5	1.3	.5	5.4	8.25	4.3
6	2.5	1.9	3.8	1.5	1.3	5.2	1.4	1.3	.5	4.55	10.35	4.35
7	2.5	1.9	4.1	1.4	1.25	4.35	1.25	1.2	.....	11.9	11.7	4.5
8	2.5	1.9	6.6	1.4	4.6	3.45	1.1	1.3	.....	11.3	10.95	4.7
9	2.5	2.0	4.2	1.45	3.5	3.05	1.1	1.1	.....	7.35	8.7	5.45
10	2.4	1.95	3.2	1.5	2.45	2.65	1.0	1.1	.....	5.45	9.35	5.3
11	2.4	1.85	2.45	1.6	1.95	2.55	1.0	2.95	.....	4.55	8.0	4.15
12	2.35	1.75	2.3	1.55	1.8	2.4	1.0	2.7	.....	6.9	6.9	4.5
13	2.3	1.7	2.2	1.5	1.65	2.25	.95	1.95	.....	8.5	6.6	4.4
14	2.3	1.8	2.2	1.5	1.45	2.15	.9	1.75	.....	5.65	6.6	4.3
15	2.2	1.8	2.65	1.4	1.3	1.95	.9	1.55	.....	4.9	6.65	4.3
16	2.2	1.7	2.5	1.4	1.2	1.85	2.9	1.45	.....	4.45	6.5	4.25
17	2.2	1.7	2.8	1.4	1.1	1.7	6.2	1.35	2.35	4.1	5.85	4.2
18	2.2	1.7	2.85	1.3	1.1	1.6	15.2	1.15	2.5	3.85	5.75	4.2
19	2.2	2.15	2.7	1.3	1.05	1.55	11.45	1.1	4.0	3.65	5.65	4.1
20	2.2	2.0	2.6	1.25	1.0	1.5	6.15	1.0	14.5	3.55	5.55	4.1
21	2.2	1.95	2.5	1.2	.9	1.7	5.1	.95	11.75	3.25	9.1	3.9
22	2.15	2.1	2.4	1.2	.9	5.65	3.25	.9	6.15	3.35	6.75	3.9
23	2.1	2.2	2.35	1.2	.9	4.85	2.75	.9	4.3	3.45	5.95	3.9
24	2.1	2.3	2.3	2.25	.9	3.6	2.45	.85	3.25	3.35	5.55	3.9
25	2.0	2.25	2.2	2.6	.95	3.3	2.25	.8	3.9	3.3	5.3	3.8
26	2.0	2.2	2.05	2.1	1.0	3.35	2.05	.8	3.85	3.2	5.2	3.7
27	2.0	2.1	2.0	1.4	1.0	3.35	1.9	.7	2.75	3.1	4.9	3.7
28	2.0	2.0	1.95	1.35	1.0	3.15	1.8	.7	2.35	3.1	4.8	3.7
29	2.0	.....	1.9	1.3	1.0	2.35	1.7	.7	2.15	3.0	4.7	3.6
30	2.0	.....	1.85	1.25	1.0	1.95	1.6	.7	2.0	3.0	4.6	3.6
31	2.0	.....	1.7	.....	8.5	.....	1.5	.7	.....	3.0	.....	3.6

NOTE.—No flow September 7-16.

CONEJOS RIVER NEAR MOGOTE, COLO.

Conejos River is the largest tributary of the Rio Grande in Colorado. Its source is the slopes of Conejos Peak and adjoining mountains, which have a general altitude of 12,000 feet. The general course is very irregular. Half of this course is in canyon, while the lower half is through the broad, almost level San Luis Valley. The lower basin is composed of gravelly mesas which merge into the level valley lands below. Rainfall data collected at Conejos by the United States Weather Bureau for a few months give the mean annual rainfall as 10 inches. The precipitation increases with the altitude to approximately 20 inches in the head waters. Irrigation as heretofore practiced has been very crude, and almost the entire normal flow of the river at low water is required for the numerous small ditches which render cultivation possible.

This station was established August 25, 1899, by A. L. Fellows, and is located 500 feet below the highway bridge 4 miles above Mogote, Colo., in T. 33 N., R. 7 W., New Mexico principal meridian. The nearest railroad station is Antonito, Colo., 12 miles east. This station was discontinued in the fall of 1900 and reestablished in the spring of 1903. The fact that Conejos River is the chief tributary of the Rio Grande in Colorado makes this station of importance, as it is above all diversions, of which there are a great many in Conejos Valley. A number of storage reservoirs are proposed for this basin.

The channel at the gage has a very gentle curve, and the bed is composed of small bowlders and cobblestones. The banks are low, of alluvial material, and will overflow during very high water. At extremely high stages, water passes through low depressions around both sides of the channel and is not registered on the gage. Such was the case during the extreme high water of June, 1905. The velocity is moderate at low water at this section. At the highway bridge above the gage the channel is 90 feet in width, with a 9-foot crib pier breaking the current at the center of stream. The section is not uniform, and is composed of bowlders and cobblestones. During the high water of June a considerable volume of water passed around the right end, running over the bridge to a depth of about 6 inches. This high water also eroded the channel greatly and changed its alignment for 1 mile above and many miles below. During August and the remaining portion of the year this section was partially obstructed by a temporary rock and log dam extending at a slight angle upstream and under the left span of the bridge. This dam was for the purpose of diverting water for irrigation and will probably go out with high water. At low water the velocity is moderate at the station, and at high stages it is very swift.

Discharge measurements are made at the gage rod during low water, and from the downstream side of the highway bridge during high water. The initial point for soundings is the face of the right abutment.

The gage is an inclined staff fastened to a large stump on the left bank of the river at Mr. King's ranch. Gage heights range from 1 to 6 feet on the gage. During 1905 the gage was read twice each day by Miss Nellie King. The bench mark is the center of three 20-penny nails driven into the base of a large cottonwood tree, 300 feet south of gage; elevation, 7.87 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 37, pp 278-279; 50, p 348; 99, p 397; 132, p 94.
Discharge: WS 37, p 279; 50, p 348; 99, p 398; 132, p 95.
Discharge, monthly: Ann 22, iv, p 348; 99, p 399; 132, p 96.
Gage heights: WS 37, p 279; 50, p 348; 99, p 398; 132, p 95.
Rating tables: WS 52, p 519; 99, p 399; 132 p 96.
Seepage computations: WS 50, p 306.

Discharge measurements of Conejos River near Mogote, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 21	R. I. Meeker	76	162	2.01	2.20	328
June 22	do	81	289	4.69	3.65	1,356
July 27	do	66	151	1.64	2.00	246
September 19[a]	do	65	61	1.02	1.30	62

[a] Wading at gage rod.

Daily gage height, in feet, of Conejos River near Mogote, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.65	3.4	4.8	3.2	1.7	1.7	1.6
2	1.4	3.4	5.1	3.0	2.2	1.6	1.55
3	1.5	3.0	5.15	3.0	2.25	1.5	1.5
4	1.55	2.8	5.55	3.35	2.4	1.5	1.4
5	1.6	2.7	5.65	3.6	2.1	1.55	1.4
6	1.6	2.55	4.4	3.65	2.2	1.55	1.4
7	1.75	2.7	5.05	2.35	2.2	1.6	1.35
8	1.85	2.85	5.35	2.65	2.15	1.5	1.3
9	2.0	3.0	5.05	2.4	2.05	1.5	1.3
10	2.1	2.85	4.9	2.55	1.9	1.5	1.3
11	2.0	2.75	4.85	2.55	2.25	1.5	1.2
12	2.0	2.75	4.7	2.45	2.1	1.4	1.2
13	2.05	3.0	4.7	2.4	1.9	1.4	1.2
14	2.0	3.1	4.6	2.4	1.9	1.4	1.2
15	2.1	3.55	4.7	2.5	1.8	1.4	1.2
16	2.05	3.9	4.55	2.5	1.7	1.4	1.2
17	2.15	4.15	4.3	2.3	1.7	1.3	1.3
18	2.2	4.3	4.2	2.2	1.65	1.35	1.3
19	2.35	4.35	4.1	2.25	1.6	1.3	1.3
20	2.2	4.45	3.95	2.4	1.65	1.3	1.3
21	2.25	4.45	3.8	2.45	1.6	1.3	1.3
22	2.35	4.5	3.7	2.45	1.6	1.3	1.3
23	2.3	4.6	3.8	2.4	1.6	1.3	1.4
24	2.2	4.75	3.7	2.2	1.6	1.25	1.5
25	2.2	4.75	3.6	2.1	1.8	1.25	1.5
26	2.3	4.85	3.55	2.0	1.7	1.4	1.4
27	2.5	4.8	3.55	2.05	1.7	1.4	1.4
28	2.7	4.6	3.5	2.2	1.65	1.4	1.4
29	2.9	4.05	3.4	2.4	1.75	1.4	1.4
30	3.05	4.25	3.3	2.3	1.7	1.65	1.4
31	.....	4.5	.....	2.15	1.7	.....	1.4

Station rating table for Conejos River near Mogote, Colo., from April 1 to June 5, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	25	2.40	425	3.40	1,120	4.40	2,180
1.50	55	2.50	480	3.50	1,210	4.50	2,300
1.60	85	2.60	540	3.60	1,310	4.60	2,430
1.70	120	2.70	600	3.70	1,410	4.70	2,560
1.80	155	2.80	660	3.80	1,510	4.80	2,690
1.90	190	2.90	725	3.90	1,610	4.90	2,820
2.00	230	3.00	795	4.00	1,720	5.00	2,950
2.10	275	3.10	870	4.10	1,830	5.20	3,230
2.20	320	3.20	950	4.20	1,940	5.40	3,510
2.30	370	3.30	1,030	4.30	2,060	5.60	3,800

The above table is applicable only for open channel conditions. It is based on one discharge measurement made during 1905 and on 1904 measurements. It is not well defined.

Station rating table for Conejos River near Mogote, Colo., from June 6 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	45	2.30	375	3.40	1,120	4.50	2,300
1.30	60	2.40	425	3.50	1,210	4.60	2,430
1.40	80	2.50	480	3.60	1,310	4.70	2,560
1.50	100	2.60	540	3.70	1,410	4.80	2,690
1.60	125	2.70	600	3.80	1,510	4.90	2,820
1.70	155	2.80	660	3.90	1,610	5.00	2,950
1.80	185	2.90	725	4.00	1,720	5.10	3,090
1.90	215	3.00	795	4.10	1,830	5.20	3,230
2.00	250	3.10	870	4.20	1,940	5.30	3,370
2.10	290	3.20	950	4.30	2,060	5.40	3,510
2.20	330	3.30	1,030	4.40	2,180		

The above table is applicable only for open channel conditions. It is based on three discharge measurements made during 1905. It is not well defined.

Estimated monthly discharge of Conejos River near Mogote, Colo., for 1905.

[Drainage area, 282 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	832	25	297	17,670	1.05	1.17
May	2,755	510	1,544	94,940	5.48	6.32
June	3,875	1,030	2,226	132,500	7.89	8.80
July	1,360	250	528	32,460	1.87	2.16
August	425	125	213	13,100	.755	.870
September	155	52	87.4	5,201	.310	.346
October	125	45	71.5	4,396	.254	.293
The period				300,300		

PECOS RIVER AT SANTA ROSA, N. MEX.

This station was established May 5, 1903, by H. C. Hurd. It was originally located at the bridge of the Chicago, Rock Island and Pacific Railway, but was moved later in the year to a point 335 feet above the railway bridge.

The bed of the river is solid rock, overlaid by quicksand to the depth of 2 or 3 feet in the long dry season. The current is never sluggish and becomes very swift during the time of floods. The channel is straight for one-fourth mile above and below the station. Both banks are high and can not overflow.

Discharge measurements are made by means of a cable. The initial point for soundings is the left end of the cable.

The original gage was a staff bolted to the masonry footing of the east tower. During the great flood of September 29 and 30, 1904, the upper portion of the gage rod was torn away, but the lower portion was left intact. A new gage was installed on the east side of the second pier to replace the one which was torn out. This new portion of the gage is bolted to the east face of the second pier from the north end of the bridge. The same flood cut away the earth from the face of the north abutment, leaving the bench mark about 25 feet above the ground and inaccessible, so in establishing the new gage reference was made to the old gage which had not been moved by the flood. During 1905 the gage was read once each day by L. M. Shely. Bench marks were established as follows: (1) A shelf cut in the east abutment; elevation, 29.70 feet. (2) A chiseled surface on the east side of the first pier from the north end of the bridge, near the top of the second stone from

the downstream end of the pier, in the second tier of stones from the bed rock, marked "B. M."; elevation, 6.41 feet. (3) The top of the downstream end of retaining wall on the east side of the river; elevation, 14.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 363-364; 132, p 97.
Discharge: 99, p 364; 132, p 97.
Gage heights: 99, pp 364-365; 132, p 98.

Discharge measurements of Pecos River at Santa Rosa, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage Height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
May 2	J. M. Giles	96	236	5.61	2.50	1,321
June 2	E. Patterson	93	196	5.28	2.10	1,035
June 5	do	93	195	5.88	2.30	1,145
July 3	do	78	37	1.49	1.10	55
July 7	do	26	14	1.03	.80	14.5
August 21	Giles and Patterson	25	12	1.19	.72	14.8
August 23	E. Patterson	24	12	1.16	.71	13.9
October 8	do	24	11	1.09	.81	12
October 24	J. M. Giles	26	13	1.16	.80	15
November 17	E. Patterson	18	10	1.19	.87	12

Daily gage height, in feet, of Pecos River at Santa Rosa, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.5	0.5	1.5	1.0	1.5	2.6	1.5	1.2	0.7	0.7	0.8	1.5
2	.5	.5	1.6	1.0	2.5	2.1	1.5	3.0	.7	.7	.8	1.0
3	.5	.5	2.0	1.0	2.5	2.0	1.5	2.5	.7	.7	.8	1.0
4	.5	.5	2.0	1.0	2.5	3.05	1.0	2.5	1.5	.7	.8	1.0
5	.5	.5	2.5	1.0	2.5	2.2	.9	2.0	1.5	.7	.8	[illegible]
6	.5	.5	3.0	1.0	2.5	2.1	.8	2.0	1.0	.7	.8	.8
7	.5	.5	3.0	1.0	3.0	1.9	.8	1.5	.9	.7	.9	[illegible]
8	.5	.6	2.0	1.5	2.5	2.0	.8	1.5	.9	.7	.8	.8
9	.5	.6	2.0	1.5	2.5	3.0	.8	1.5	.9	.8	1.0	.8
10	.5	.6	2.0	1.5	2.5	2.3	.8	1.5	.9	.8	1.1	[illegible]
11	.5	.6	2.0	2.5	2.5	2.0	.7	1.5	.9	.8	.9	.8
12	.5	.6	1.5	2.5	2.5	2.5	.7	2.5	1.3	.8	.9	.9
13	.5	.6	1.5	1.5	2.5	2.5	.7	2.0	1.0	.8	.9	.8
14	.5	.6	1.5	1.5	3.0	2.0	.7	1.5	1.0	.8	.9	[illegible]
15	.4	.6	1.4	1.5	2.5	1.7	.7	1.5	1.0	.8	.9	[illegible]
16	.4	.6	1.4	1.5	2.5	1.7	.7	1.5	1.0	.8	.9	.6
17	.4	.6	1.4	1.5	2.5	1.0	.7	1.0	.8	.8	.9	.6
18	.4	.6	1.4	1.5	2.5	1.0	.7	.9	.8	.8	.9	.6
19	.4	.6	1.4	1.5	2.5	1.0	.7	.8	.8	.8	.9	.5
20	.4	.8	1.4	1.5	2.5	1.0	.7	.7	.7	.8	.9	.5
21	.4	.8	1.4	1.5	2.5	1.0	.9	.7	.7	.8	.9	[illegible]
22	.4	1.0	1.4	1.5	2.5	1.0	2.5	.7	.7	.8	.9	[illegible]
23	.4	1.5	1.4	3.5	2.5	1.0	1.5	.7	.7	.8	4.0	[illegible]
24	.4	1.5	1.4	3.0	2.8	1.0	1.5	.7	.7	.8	2.5	[illegible]
25	.4	3.0	1.4	3.0	3.0	1.0	1.5	.7	.7	.8	1.5	[illegible]
26	.4	1.5	1.4	2.5	2.5	1.5	1.0	.7	.7	.8	1.5	[illegible]
27	.4	1.5	1.4	2.5	2.5	1.5	1.0	.7	.7	.8	3.0	[illegible]
28	.4	1.5	1.4	2.5	2.5	1.5	1.0	.7	.7	.8	1.0	[illegible]
29	.5	.....	1.4	2.5	2.5	1.5	1.0	.7	.7	.8	2.0	[illegible]
30	.5	.....	1.4	3.0	2.5	1.5	1.0	.7	.7	.8	1.6	[illegible]
31	.5	.....	1.4	.....	2.0	.....	1.0	.7	.....	.8	.....	.6

PECOS RIVER NEAR FORT SUMNER, N. MEX.

This station was established June 12, 1904, by Earl Patterson. It is located about 12 miles northwest of Fort Sumner, N. Mex., and 45 miles south of Santa Rosa, N. Mex., the nearest railway station. It was originally located 1 mile upstream from the spring, trees, and houses known as Arinosa, but was relocated July 5, 1905, near the spring.

Both banks are high and will not overflow except in extreme high water. The bed of the river is clean, shifting sand.

Discharge measurements are made by wading at or near the gage.

The gage is an inclined staff bolted to a ledge of sandstone on the right bank. During 1905 the gage was read twice each day by J. C. Pacheco. Bench marks were established as follows: (1) The head of a bolt set in the rock 14 feet upstream from gage; elevation, 7.48 feet. (2) A cross cut in the sandstone ledge 5 feet downstream from gage; elevation, 7.11 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 132 of the United States Geological Survey, pp. 98101.

Discharge measurements of Pecos River near Fort Sumner, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second feet.*
July 4	E. Patterson	84	68	1.56	1.40	107
July 6	do	91	55	1.55	1.30	86
August 22	Giles and Patterson	46	52	1.64	1.40	85
October 9	E. Patterson	75	62	1.48	1.45	92
November 18	do	80	59	1.60	1.50	95
([a])	J. M. Giles		200	1.76	2.00	352
([a])	do		405	2.70	3.00	1,093
([a])	do		615	3.36	4.00	2,066

[a] Computed from slope measurement, using Kutter's formula.

Daily gage height, in feet, of Pecos River near Fort Sumner, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.4	0.3	2.95	1.3	2.3	2.3	1.4	1.8	1.4	1.4	1.55	1.75
2	.4	.3	2.6	1.35	2.4	2.2	1.7	1.5	1.4	1.4	1.5	1.8
3	.4	.3	2.25	1.3	2.45	2.25	1.55	2.0	1.4	1.4	1.55	1.75
4	.4	.8	2.0	1.3	2.4	1.95	1.45	1.72	1.4	1.4	1.65	1.65
5	.4	.8	.85	1.2	2.2	2.8	1.4	2.22	3.2	1.4	1.55	1.65
6	.4	.8	.75	1.3	2.15	2.3	1.3	1.87	1.6	1.4	1.6	1.65
7	.4	.8	.7	1.3	1.95	2.25	1.4	1.87	1.5	1.4	1.6	1.75
8	.4	.9	1.1	1.2	2.05	2.1	1.35	2.15	1.6	1.4	1.6	1.7
9	.4	.7	1.0	1.2	2.25	2.4	1.4	1.85	1.6	1.45	1.7	1.65
10	.4	.6	1.25	1.2	2.3	2.45	1.4	1.77	1.5	1.5	1.7	1.6
11	.4	.6	1.3	1.35	2.3	2.6	1.4	1.7	1.7	1.5	1.7	1.75
12	.4	.6	1.2	1.6	2.2	2.35	1.4	1.9	1.5	1.45	1.65	1.8
13	.4	.6	1.2	1.7	2.0	2.3	1.4	2.3	1.5	1.45	1.6	1.95
14	.4	.6	1.2	1.4	2.05	2.35	1.4	1.77	1.45	1.45	1.6	1.7
15	.4	.6	1.2	1.4	2.15	2.2	1.4	1.52	1.45	1.45	1.55	1.75
16	.4	.6	1.2	1.5	2.2	2.1	1.35	1.5	1.4	1.4	1.6	1.7
17	.4	.6	1.15	1.5	2.35	1.9	1.35	1.47	1.35	1.45	1.55	1.7
18	.3	.6	1.1	1.45	2.4	1.8	1.35	1.42	1.3	1.45	1.5	1.7
19	.3	.6	1.0	1.75	2.55	1.9	1.35	1.42	1.25	1.4	1.5	1.75
20	.3	.5	.9	1.6	3.1	1.8	1.35	1.4	1.35	1.4	1.55	1.75
21	.3	.6	.8	1.7	2.95	1.8	1.4	1.4	1.3	1.4	1.6	1.7
22	.3	.7	1.1	1.7	2.5	1.9	2.1	1.4	1.3	1.4	1.65	1.6
23	.3	1.3	1.0	2.7	3.3	1.75	2.0	1.4	1.35	1.45	2.2	1.5
24	.4	1.55	.9	2.95	2.75	1.7	1.7	1.45	1.35	1.45	2.7	2.25
25	.4	1.2	.8	2.95	2.9	1.7	1.6	1.45	1.35	1.5	2.1	1.95
26	.4	1.05	.8	2.4	2.25	1.7	1.6	1.4	1.35	1.5	1.75	1.85
27	.4	.9	.9	2.2	2.25	1.6	1.6	1.4	1.35	1.5	1.6	1.85
28	.4	.9	.95	2.45	2.5	1.6	1.5	1.4	1.45	1.5	1.7	1.8
29	.4	.....	1.0	2.45	2.4	1.6	1.5	1.4	1.4	1.5	1.85	1.8
30	.3	.....	1.1	2.35	2.4	1.5	1.52	1.4	1.5	1.6	2.1	1.75
31	.3	.....	1.0	.....	2.3	.....	1.45	1.4	.....	1.55	.....	2.4

Daily discharge, in second-feet, of Pecos River near Fort Sumner, N. Mex., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	260	85	90	120	225
2	.....	120	85	90	110	260
3	.....	360	85	90	115	225
4	.....	220	85	90	135	180
5	105	490	1,250	90	110	180
6	85	295	170	90	120	180
7	105	295	130	90	115	225
8	95	450	170	90	110	200
9	105	285	170	95	130	180
10	105	245	130	105	130	140
11	105	210	215	105	130	210
12	105	310	130	95	120	240
13	105	550	130	95	110	325
14	105	245	117	95	110	200
15	105	128	117	95	100	210
16	95	120	105	90	105	200
17	95	110	95	95	100	200
18	95	90	85	95	95	200
19	95	90	85	90	95	210
20	95	85	95	90	100	210
21	105	85	85	90	105	190
22	420	85	85	90	115	140
23	360	85	95	95	480	95
24	215	102	95	95	825	500
25	170	102	95	105	420	325
26	170	85	95	105	230	265
27	170	85	97	105	157	265
28	130	85	117	105	210	240
29	130	85	105	105	280	240
30	130	85	130	160	420	210
31	117	85	.....	130	.....	600

NOTE.—Daily discharge determined by indirect method as applied to shifting channels. As no measurements were made prior to July 4, no estimates have been made for that period.

Estimated monthly discharge of Pecos River near Fort Sumner, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 5-31	420	85	138	7,391
August	550	85	191	11,740
September	1,250	85	151	8,985
October	160	90	98.4	6,050
November	825	95	183	10,890
December	600	95	235	14,450
The period	.....	.....	.....	59,510

PECOS RIVER NEAR ROSWELL, N. MEX.

This station was established April 24, 1903, by W. M. Reed. It is located at the highway bridge 8 miles southeast of Roswell, N. Mex., and about 200 feet below the mouth of Hondo River.

The channel is straight for one-half mile above and below the station and has a width at low water of about 50 feet and at ordinary high water of 430 feet. The channel is broken by

two iron piers. The current is rapid except near the mouth of Hondo River, where it becomes sluggish. At high water the Pecos and the Hondo join above the bridge. The gage heights on the Pecos may be affected by back water at periods when the Pecos is low and the Hondo is high. Both banks are high and free from timber, but they overflow at extreme flood stages. The bed is sandy and shifting, and the cross section changes during each flood.

Discharge measurements are made from the highway bridge. The initial point for soundings is a zero marked on the guard rail at the west end and north side of the bridge.

The original gage is painted on the right side of the right pier of the bridge. September 15, 1905, a standard chain was bolted to the upstream fencing of the bridge 325 feet from the initial point for soundings; length of chain, 26.45 feet. During 1905 the gage was read twice each day by Miss Dovie Goldsmith. Bench marks were established as follows: (1) The top of the pier upon which the original gage is painted; elevation, 20.10 feet. (2) The top of angle bar connecting fencing with first upright east of pier on which the gage is painted; elevation, 25.17 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 360; 132, p 101.
Discharge: 99, p 360; 132, p 102.
Gage heights: 99, p 361; 132, p 102.

Discharge measurements of Pecos River near Roswell, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 28	E. Patterson	290	433	2.10	2.90	910
March 28	F. S. Dobson	164	260	1.65	2.00	431
April 12	Giles and Mitchell	176	274	2.21	2.55	605
April 26	E. Patterson	317	729	4.53	4.50	3,305
April 28	do	304	415	3.13	3.40	1,300
May 23	do	364	682	4.48	4.50	3,059
June 14	do	362	535	2.92	3.70	1,565
July 10	do	106	74	.85	2.30	63
July 18	do	36	39	.81	1.90	32
July 24	do	370	765	4.74	5.80	3,631
July 25	do	371	1,300	5.25	6.80	6,821
July 27	do	223	618	4.47	4.50	2,761
August 2	J. M. Giles	210	377	1.90	3.40	721
August 9	E. Patterson	379	498	3.26	3.80	1,625
August 26	do	112	133	.80	1.80	106
August 28	do	120	108	.71	1.70	77
September 4	do	104	96	.76	1.70	74
September 6	do	219	1,063	5.88	5.90	6,250
September 7	do	204	541	2.45	3.50	1,327
September 8	do	214	430	3.10	3.60	1,336
September 9	do	150	198	2.38	2.80	472
September 11	do	137	187	2.19	2.75	409
October 4	do	102	113	1.35	2.45	153
October 13	do	101	85	1.04	2.25	89
October 13	J. M. Giles	90	92	1.14	2.25	105
October 23	E. Patterson	101	89	1.07	2.30	97
October 30	do	100	93	1.04	2.30	97
November 5	do	.....	270	1.23	3.00	333
November 10	do	.....	328	1.93	3.00	634
November 24	J. M. Giles	.....	710	3.20	4.10	2,273
November 25	do	.....	686	2.81	4.00	1,928
December 11	E. Patterson	180	308	1.28	2.60	398

Daily gage height, in feet, of Pecos River near Roswell, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.2	2.5	2.3	3.3	3.5	2.5	3.3	1.8	2.1	2.5	3.5
2	1.2	1.2	2.5	3.0	3.35	3.4	2.5	3.0	1.8	2.1	2.5	3.2
3	1.2	1.2	2.3	2.45	3.2	3.4	2.5	4.0	1.8	2.2	2.6	3.2
4	1.2	1.2	2.3	2.3	3.2	3.4	2.5	3.3	1.8	2.4	3.0	3.0
5	1.0	1.3	2.9	2.3	3.2	3.4	2.5	3.2	1.8	2.4	3.0	2.8
6	1.0	1.3	2.3	2.35	3.2	4.5	2.5	3.2	7.5	2.3	3.0	2.6
7	1.0	2.0	2.5	2.45	3.45	5.0	2.4	3.2	3.7	2.3	3.0	2.6
8	1.0	2.0	4.0	2.45	3.35	4.0	2.4	3.0	3.6	2.3	3.0	2.6
9	1.0	2.2	3.0	2.4	3.35	3.5	2.3	3.8	2.9	2.2	3.3	2.6
10	1.6	2.2	3.0	2.4	3.2	3.5	2.3	3.4	3.7	2.2	3.0	2.6
11	2.0	2.0	3.9	2.45	3.1	4.0	2.3	3.4	3.0	2.2	3.0	2.7
12	2.0	2.0	3.0	2.5	3.5	4.0	2.3	3.3	2.5	2.2	3.0	2.7
13	2.6	2.4	3.0	2.5	3.45	4.4	2.2	3.2	2.45	2.2	3.0	2.7
14	2.0	2.4	2.9	2.45	3.35	3.7	2.2	3.2	2.45	2.1	2.8	2.7
15	1.1	2.0	2.9	2.45	3.25	3.5	2.2	3.2	2.45	2.1	2.8	2.7
16	1.6	2.6	2.8	2.45	3.25	3.5	2.0	2.8	2.4	2.1	2.8	2.7
17	1.4	2.8	2.6	2.45	3.3	3.5	2.0	2.6	2.4	2.1	2.8	2.7
18	1.0	2.7	2.6	2.45	3.45	3.5	2.0	2.5	2.4	2.1	2.8	2.5
19	1.0	2.5	2.3	2.45	3.45	3.5	6.2	2.3	2.3	2.1	2.6	2.5
20	1.6	2.3	2.2	2.45	3.5	3.5	3.3	2.3	2.2	2.1	2.6	2.5
21	2.0	2.6	2.0	2.45	3.8	3.5	3.0	2.0	2.2	2.1	2.6	2.5
22	2.4	2.6	2.0	2.45	4.45	3.5	3.0	2.0	2.2	2.1	2.6	2.5
23	2.4	2.0	2.0	5.35	4.45	3.5	10.0	2.0	2.2	2.1	2.6	2.5
24	2.4	2.0	2.0	5.0	4.45	3.3	6.0	2.0	2.2	2.1	4.75	2.5
25	2.0	2.6	2.0	4.0	4.45	3.3	6.7	1.8	2.1	2.1	3.85	2.5
26	2.0	3.6	2.6	4.45	4.45	3.3	5.6	1.8	2.1	2.3	3.5	2.5
27	1.1	3.0	2.4	3.75	4.45	3.3	4.3	1.8	2.1	2.3	3.3	2.5
28	1.8	2.5	2.0	3.3	4.0	3.3	3.8	1.8	2.1	2.4	3.0	2.5
29	1.3	.....	2.0	3.3	3.7	3.3	3.4	1.8	2.1	2.4	2.8	2.4
30	1.2	.....	2.0	3.3	3.7	3.0	3.4	1.8	2.1	2.45	3.5	2.4
31	1.2	.....	2.0	.....	3.5	.....	3.4	1.8	.....	2.45	.....	2.4

PECOS RIVER NEAR DAYTON, N. MEX.

This station was established March 24, 1905. It was located about 3 miles east of Dayton, N. Mex., 100 feet below the mouth of Penasco River and about 6 miles above McMillan dam at Lakewood, N. Mex. The gage was washed out September 6, 1905, and the station was relocated September 7, 1905, about one-half mile upstream.

The channel is straight for 200 feet above and 500 feet below the station. The right bank is high and the cable will be accessible until the river rises above 10 feet on the gage. The left bank is about the same height. The bed is clean shifting sand and the current good.

Discharge measurements were made by means of a cable at the original location until the new gage was established, when the cable was reerected about 100 yards below the new gage.

The present gage is a staff fastened to posts driven into the right bank. During 1905 the gage was read once each day by Eugene Lattion. The bench mark is a nail in the upstream side of the post under the cable on the right bank; elevation, 13.90 feet above the datum of the gage..

Discharge measurements of Pecos River near Dayton, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 18	J. M. Giles	145	327	1.71	2.52	559
May 8	E. Patterson	188	516	3.04	4.60	1,572
May 15	J. M. Giles	149	409	2.80	4.18	1,145
May 28	E. Patterson	192	510	3.83	5.20	1,956
June 13	do	193	644	3.60	5.30	2,319
July 1	J. M. Giles	109	145	1.33	2.60	193
July 1	do	109	145	1.29	2.60	187
July 11	E. Patterson	72	96	1.05	1.95	101
July 15	do	71	84	1.07	1.90	91
July 23	do	196	744	3.25	5.60	2,422
July 23	do	196	789	3.32	5.80	2,623
July 23	do	196	823	3.64	6.00	3,000
September 1 [a]	do	140	170	.80	1.50	137
September 6 [a]	J. M. Giles	94	126	1.55	1.72	196
September 9	do	171	552	1.82	3.40	1,006
September 9	do	170	491	1.84	3.15	905
September 12	do	96	161	2.61	1.95	419
September 12	do	96	163	2.80	2.05	456
September 15	E. Patterson	96	108	2.14	1.50	235
October 4	J. M. Giles	109	142	1.62	1.65	230
October 4	do	109	143	1.68	1.67	240
October 15	E. Patterson	112	142	1.60	1.70	228
October 21	do	111	139	1.46	1.67	204
November 7	do	.....	204	1.71	2.26	349
November 23	J. M. Giles	.....	241	1.76	2.40	425
November 23	do	.....	238	1.79	2.40	427
November 26	do	.....	759	2.20	4.30	1,668
November 28 [b]	do	.....	380	1.55	3.00	588
November 28 [b]	do	.....	378	1.62	3.05	612
December 8	E. Patterson	.....	280	2.08	2.60	583
December 28	do	.....	202	1.63	2.30	329

[a] Measurement by wading. [b] Backwater from McMillan reservoir.

NOTE.—Measurements April 18 to September 1 made below the mouth of the Penasco; after September 1 made above mouth of Penasco.

Daily gage height, in feet, of Pecos River near Dayton, N. Mex., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.85	5.1	4.6	2.5	3.4	1.5	1.4	1.6	3.5
2	.....	1.85	4.95	4.5	2.5	3.8	1.7	1.5	1.9	3.5
3	.....	2.5	4.9	4.3	2.4	3.9	2.2	1.6	1.5	3.5
4	.....	2.1	4.9	4.5	2.3	4.0	2.5	1.7	2.0	3.4
5	.....	2.65	5.1	4.2	2.3	3.6	2.3	1.7	2.2	3.4
6	.....	2.3	5.2	4.3	2.2	3.6	1.7	1.7	2.2	3.0
7	.....	2.3	5.2	5.6	2.1	3.4	4.5	1.7	2.2	2.9
8	.....	2.25	5.0	4.5	2.1	5.0	3.4	1.7	2.3	2.9
9	.....	2.25	5.4	4.4	2.2	4.8	3.3	1.6	2.4	2.7
10	.....	2.15	4.9	4.4	2.1	4.5	2.8	1.6	3.0	2.7
11	.....	2.15	4.7	4.6	2.1	3.8	2.5	1.6	2.9	2.7
12	.....	2.1	4.3	6.0	2.0	3.5	2.0	1.7	2.9	2.7
13	.....	3.0	4.3	5.4	2.0	3.3	2.2	1.8	2.7	2.7
14	.....	3.3	4.4	4.6	2.0	3.4	2.0	1.5	2.6	3.1
15	.....	3.0	4.2	4.7	2.0	4.0	1.5	1.7	2.5	3.0
16	.....	3.5	4.0	4.5	2.0	3.9	1.7	1.7	2.5	3.0
17	.....	3.55	4.2	4.6	1.9	3.0	1.8	1.7	2.6	2.9
18	.....	3.3	4.2	4.3	1.8	2.8	1.5	1.7	2.9	2.9
19	.....	3.5	4.0	4.2	1.8	2.9	1.3	1.7	2.3	2.9
20	.....	3.3	4.2	4.0	3.8	2.5	3.0	1.7	2.3	2.7
21	.....	3.25	6.5	3.7	3.0	2.3	2.0	1.7	2.3	2.7
22	.....	3.3	4.9	3.7	2.8	2.0	1.5	1.7	2.5	2.7
23	.....	4.1	5.2	3.6	10.9	2.2	1.4	1.7	2.4	2.7
24	2.5	5.6	4.5	3.4	.....	1.8	1.5	1.7	4.5	2.8
25	2.3	6.45	6.2	3.9	.....	1.7	1.5	1.6	5.4	3.2
26	2.25	5.7	5.4	3.2	.....	1.7	1.5	1.7	4.2	2.55
27	1.85	5.85	5.0	3.1	5.9	1.6	1.5	1.7	3.6	2.5
28	1.85	5.2	5.0	3.0	5.5	1.6	1.4	1.6	3.2	2.5
29	2.0	4.95	5.7	3.0	4.9	1.5	1.5	1.6	2.9	2.6
30	2.0	4.7	4.7	2.6	4.2	1.2	1.5	1.6	3.4	2.4
31	1.85	.....	4.7	.....	3.7	1.2	.....	1.6	.....	3.0

NOTE.—Water above gage July 24-26.

PECOS RIVER AT CARLSBAD, N. MEX.

This station was established May 20, 1903, by V. L. Sullivan. It is located at the Green Street Bridge, Carlsbad, N. Mex., and is about 500 feet below the station of the Pecos Valley and Northeastern Railway and 2,000 feet below the Hagerman power dam.

Both banks are high and not subject to overflow. The bed of the river is solid rock, much corrugated, which makes low-water measurements subject to considerable inaccuracy. The The channel is straight for some distance above and below the station. The current is swift at the station, but sluggish, both above and below.

Discharge measurements are made by wading when the stage of the river will permit, and from the lower side of the bridge during floods. The initial point for soundings is on the south side of the bridge at the west abutment.

The bridge and original gage were carried away by the flood of October, 1904. The new gage is in three sections: The first is a vertical section, reading from 0 to 6 feet, spiked to the abutment on the right bank. The second section, reading from 6 to 10 feet, is spiked to a post on the right bank. The third section, reading from 9 to 19 feet, is nailed to a pile in the railroad trestle over a ravine about 100 feet south of Green street and 100 feet from the river bank. The datum is the same as that of the original gage. During 1905 the gage was read twice a day by V. L. Sullivan, a civil engineer in the employ of the Pecos Valley Irrigation Company. The bench mark is the northeast corner of the stone threshold at the door of the men's waiting room of the Pecos Valley and Northeastern Railway depot; elevation, 25.63 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 358-359; 132, p 103.
Discharge: 99, p 359; 132, p 103.
Gage heights: 99, pp 359-360; 132, p 104.

Discharge measurements of Pecos River at Carlsbad, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 24	F. S. Dobson	190	671	2.10	2.39	1,413
March 13	V. L. Sullivan	190	1,236	2.42	4.05	3,001
May 8	Murphy and Giles	212	765	3.84	4.10	2,941
May 9	do	202	608	4.51	3.95	2,740
May 13	J. M. Giles	165	169	1.98	1.25	334
July 5	do	103	113	2.30	1.13	261
July 10	do	120	185	3.66	1.76	678
July 25[a]	V. L. Sullivan	310	4,110	13.36	15.85	54,930
July 26[a]	do	290	3,151	12.29	12.60	38,730
July 27[a]	do	260	2,266	10.76	9.85	24,380
July 28	do	245	1,403	8.05	7.00	11,300
August 5	J. M. Giles	189	870	2.39	3.43	2,082
August 7	do	182	708	2.04	2.70	1,441
October 10	do	.....	86	2.36	1.07	203
October 11	do	78	87	2.36	1.07	207
November 27	do	.....	407	4.72	3.05	1,923

[a] Made by floats.

Daily gage height, in feet, of Pecos River at Carlsbad, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.23	1.89	2.81	1.3	3.87	1.85	1.2	3.9	1.19	1.28	1.42	2.19
2	1.23	1.88	2.8	1.29	3.77	1.4	1.18	4.15	1.2	1.58	1.44	2.21
3	1.23	1.88	2.79	1.27	1.65	1.1	1.18	4.77	1.55	1.61	1.44	2.26
4	1.23	1.88	2.4	1.26	1.4	1.12	1.18	3.57	1.24	1.58	1.48	2.31
5	1.23	1.88	1.4	1.28	1.4	1.7	1.19	3.45	1.48	1.55	1.44	2.16
6	1.23	1.88	2.12	1.3	1.67	2.9	1.19	3.25	1.49	1.15	1.44	2.09
7	1.23	1.88	2.5	1.28	4.35	4.05	1.18	2.9	1.84	1.11	1.27	2.02
8	1.23	1.87	2.8	1.29	4.2	4.2	1.18	2.57	3.0	1.08	1.2	1.92
9	1.23	1.87	3.13	1.29	3.95	4.05	1.91	2.4	3.0	1.08	1.45	1.86
10	1.23	1.87	3.18	1.3	1.55	3.78	1.77	2.15	2.58	1.08	1.47	1.84
11	1.23	1.87	3.2	1.3	1.65	3.47	1.68	2.51	2.09	1.08	1.77	1.82
12	1.23	1.87	4.19	1.31	2.35	1.69	1.55	2.62	1.9	1.09	1.98	1.81
13	1.23	1.87	4.06	1.32	1.35	2.68	1.36	2.72	1.62	1.1	1.98	1.87
14	1.23	1.85	3.96	1.32	1.29	3.57	1.2	2.27	1.55	1.11	1.96	1.89
15	1.23	1.85	3.78	1.32	1.26	3.82	1.17	2.13	1.04	1.12	1.75	1.88
16	1.23	1.85	3.55	1.62	1.26	3.7	1.15	2.07	1.03	1.12	1.75	1.88
17	1.23	1.85	3.29	1.64	1.27	3.41	1.14	2.12	1.01	1.13	1.75	1.86
18	1.24	1.84	2.93	1.9	1.28	3.12	1.1	1.9	.99	1.13	1.75	1.82
19	1.24	1.84	2.65	1.91	1.29	2.75	1.0	1.7	.99	1.13	1.74	1.8
20	1.24	1.83	2.35	1.96	2.05	2.35	.99	1.65	1.0	1.14	1.73	1.75
21	1.24	1.83	1.2	2.0	3.6	2.1	1.48	1.52	1.0	1.14	1.72	1.68
22	1.24	1.83	1.18	2.1	3.52	1.23	1.54	1.47	1.04	1.14	1.71	1.62
23	1.24	1.83	1.19	2.05	3.6	1.23	2.77	1.45	1.06	1.14	1.7	1.6
24	1.24	2.39	1.22	2.5	2.4	1.23	8.67	1.43	1.06	1.15	1.69	1.64
25	1.24	2.38	1.23	4.3	3.8	1.22	14.39	1.37	1.08	1.15	1.69	1.68
26	1.3	2.36	1.25	4.38	4.2	1.22	12.42	1.31	1.1	1.15	2.61	1.61
27	1.6	2.35	1.28	4.28	3.91	1.21	10.0	1.25	1.18	1.16	3.11	1.6
28	1.9	2.6	1.3	4.15	3.77	1.2	7.0	1.28	1.22	1.16	2.95	1.58
29	1.9	.....	1.28	4.1	3.6	1.2	5.35	1.25	1.12	1.17	2.67	1.56
30	1.9	.....	1.28	4.02	3.6	1.2	4.5	1.22	1.12	1.17	2.45	1.55
31	1.89	.....	1.28	.....	3.6	.....	4.15	1.2	.....	1.17	.....	1.54

Station rating table[a] *for Pecos River at Carlsbad, N. Mex., from May 29, 1903, to December 31, 1905.*

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
.30	22	2.00	870	3.70	2,470	6.80	10,520
.40	35	2.10	950	3.80	2,610	7.00	11,300
.50	50	2.20	1,030	3.90	2,750	7.20	12,080
.60	70	2.30	1,110	4.00	2,900	7.40	12,870
.70	95	2.40	1,190	4.20	3,220	7.60	13,670
.80	125	2.50	1,275	4.40	3,570	7.80	14,500
.90	165	2.60	1,360	4.60	3,940	8.00	15,400
1.00	210	2.70	1,445	4.80	4,350	8.20	16,360
1.10	255	2.80	1,530	5.00	4,800	8.40	17,320
1.20	305	2.90	1,615	5.20	5,290	8.60	18,280
1.30	360	3.00	1,700	5.40	5,820	8.80	19,240
1.40	420	3.10	1,790	5.60	6,380	9.00	20,200
1.50	490	3.20	1,890	5.80	6,970	9.20	21,160
1.60	560	3.30	1,990	6.00	7,600	9.40	22,120
1.70	635	3.40	2,100	6.20	8,290	9.60	23,080
1.80	710	3.50	2,220	6.40	9,020	9.80	24,040
1.90	790	3.60	2,340	6.60	9,760	10.00	25,000

[a] The above table is not strictly applicable June 13 to 22, 1903, owing to a considerable change in the high-water section during the flood of October, 1904.

The above table is based on two discharge measurements made during 1903, three made during 1904, and 16 made during 1905. It is fairly well defined between gage heights 1 foot and 16 feet. Below 1 foot it is subject to error as high as 20 per cent.

Estimated monthly discharge of Pecos River at Carlsbad, N. Mex., for 1903.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June[a]	15,640	119	1,959	116,600
July	390	110	164	10,080
August	110	82	92.7	5,700
September	85	82	82.8	4,927
October	82	80	81.5	5,011
November	82	80	81.7	4,862
December	82	80	80.3	4,938
The period				152,100

[a] See rating table footnote.

Estimated monthly discharge of Pecos River at Carlsbad, N. Mex., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	161	80	99.4	6,112
February	141	90	94.0	5,407
March	137	22	85.0	5,226
April	90	88	88.1	5,242
May	110	0	84.3	5,183
June	122	75	91.4	5,439
July	107	95	96.5	5,934
August	420	104	132	8,116
September	224	107	152	9,045
October 1-2; 11-31	30,200	1,190	4,269	194,800
November	1,530	255	695	41,360
December 1-24	766	295	521	24,800
The period				316,700

Estimated monthly discharge of Pecos River at Carlsbad, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	790	322	392	24,100
February	1,360	734	838	46,540
March	3,204	295	1,266	77,840
April	3,534	338	1,079	64,210
May	3,480	338	1,574	96,780
June	3,220	255	1,256	74,740
July	47,600	206	5,236	321,900
August	4,287	305	1,164	71,570
September	1,700	206	486	28,920
October	568	246	308	18,940
November	1,800	305	739	43,970
December	1,118	518	742	45,620
The year	47,600	206	1,257	915,100

PECOS RIVER AND MARGUERETTA FLUME NEAR PECOS, TEX.

This station was established January 1, 1898, by Thomas U. Taylor, and is located about 6 miles above Pecos, Tex., at the flume of the Barstow Irrigation Company (old Margueretta Canal Company). The canal diverts the water from Pecos River 3 miles above the flume from the west side of the river. The water, except about 10 second-feet taken by the West Valley ditch, is carried across to the east side by a timber flume supported on pile bents.

The channel is straight for 300 feet above and 100 feet below the measuring section. The river bed is sandy and shifting. In floods such as those of October, 1904, and July, 1905, a large volume of water passes down the West Valley, west of the canal. This water spreads over the country from the flume to Pecos and can not be measured with any accuracy.

Discharge measurements are made from a cable about 200 yards below the flume. The initial point for soundings is the post supporting the cable on the west bank. Measurements taken in the flume at the east end show the amount of water used for irrigation on the east side of the river.

The gage is a staff which is nailed to one of the piles under the upstream side of the flume. The gage in the flume is at the east end and has its zero at the bottom of the flume. During 1905 both gages were read by Lawrence Vauter, gate keeper for the irrigation company. Bench marks were established as follows: (1) The top of the west abutment on the north side of the flume, marked "U. S. G. S. B. M. 21.70;" elevation, 21.70 feet. (2) On the stone wall on the south side of the canal, under the window of the gate keeper's house, marked "U. S. G. S. B. M. 20.95;" elevation, 20.95 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Pecos River near Pecos, Tex.

Description: WS 28, p 119; 37, p 285; 50, p 358; 66, p 76; 84, pp 168-169; 99, p 355; 132, pp 104-105.
Discharge: WS 28, p 130; 37, p 385; 50, p 359; 66, p 77; 84, p 169; 99, p 356; 132, p 105.
Discharge, monthly: WS 84, p 172; 99, p 358; 132, p 109.
Discharge, yearly: Ann 20, iv, p 57.
Gage heights: WS 28, p 125; 37, p 286; 50, pp 360-361; 66, p 77; 84, p 170; 99, p 356; 132, p 106.
Rating tables: WS 84, p 171; 99, p 357; 132, p 108.

Margueretta flume near Pecos, Tex.

Description: WS 84, pp 168-169; 99, p 355; 132, pp 104-105.
Discharge: WS 50, p 360; 66, p 77; 84, p 169; 132, p 105.
Gage heights: WS 50, p 361; 84, p 171; 99, p 357; 132, p 107.
Rating table: WS 132, p 108.

Discharge measurements of Pecos River near Pecos, Tex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 10	Murphy and Giles	144	695	3.55	6.10	2,470
July 11	J. M. Giles	81	105	1.81	1.27	189
July 11	do	81	103	1.72	1.25	177
July 14	E. Patterson	99	150	2.50	2.20	376
August 11	J. M. Giles	172	496	2.66	3.25	1,318
August 12	do	170	463	2.82	3.20	1,304
August 31	E. Patterson	96	205	2.10	1.20	432
September 13	do	90	359	2.49	2.50	895
September 14	do	89	326	2.39	2.20	779
October 6	J. M. Giles	138	254	1.81	1.40	459
October 7	do	138	263	1.95	1.50	513
October 16	E. Patterson	82	92	1.45	0.20	134
October 20	do	80	88	1.30	0.10	115
November 8	do		184	1.87	1.00	334
November 16	Grover and Giles		413	2.12	2.22	873
November 17	J. M. Giles		398	2.24	2.20	884
December 6	E. Patterson	169	444	2.37	2.80	1,055
(a)	J. M. Giles		1,304	4.92	8.00	6,416
(a)	do		2,024	6.32	12.00	12,790
(a)	do		3,140	7.91	18.00	24,840

a Computed from slope measurement, using Kutter's formula.

Daily gage height, in feet, of Pecos River, near Pecos, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.5	4.3	2.1	5.0	5.5	2.5	7.6	1.4	.....	0.2	2.8
2	2.0	2.5	4.3	2.0	4.3	5.0	1.5	6.2	.....	.....	.2	2.6
3	2.1	2.5	4.3	1.9	3.0	3.9	1.5	5.65	.....	.....	.2	2.4
4	2.1	2.5	4.3	1.9	3.0	2.9	1.5	6.15	.....	.....	.4	2.3
5	2.1	2.5	4.1	1.9	3.0	2.0	1.5	5.85	.....	.....	.9	2.0
6	2.1	2.5	4.1	1.9	2.8	1.9	1.5	4.9	.....	1.4	.9	1.9
7	2.1	2.9	4.1	1.6	2.6	3.1	1.4	4.5	.....	1.5	1.0	2.0
8	2.1	3.0	4.1	1.6	2.6	4.0	1.4	4.0	.....	1.4	1.1	2.3
9	2.1	3.1	4.1	1.5	6.0	6.0	1.4	3.7	1.4	.9	1.0	2.4
10	2.1	3.2	4.1	1.4	6.1	6.2	1.2	3.6	4.5	.3	1.0	2.4
11	2.1	3.2	4.6	1.4	6.0	6.0	2.5	3.5	3.5	.3	1.0	2.4
12	2.1	3.1	4.6	1.4	3.0	5.8	2.3	3.2	3.2	.2	1.1	2.4
13	2.1	3.1	5.9	1.3	2.6	5.9	2.2	3.4	2.6	.2	1.4	2.1
14	2.1	3.1	6.6	1.1	3.6	4.9	1.9	3.6	2.2	.2	2.4	2.0
15	2.1	3.1	6.6	1.1	3.2	3.2	1.5	3.5	2.1	.2	2.3	2.0
16	2.1	3.1	6.5	1.1	2.5	5.0	1.4	3.0	2.1	.2	2.2	2.0
17	2.1	3.1	6.2	1.1	2.0	5.9	1.4	3.0	.....	.2	2.2	2.0
18	2.1	3.1	6.1	1.6	1.9	6.0	1.0	2.9	.....	.2	1.8	2.1
19	2.1	3.1	6.0	1.7	1.5	5.6	.9	2.9	.....	.2	1.8	2.1
20	2.1	3.0	5.0	1.8	1.0	4.9	.9	2.8	.....	.1	1.8	2.0
21	2.1	3.0	5.1	2.0	1.0	4.0	.9	2.8	.....	.1	1.8	2.0
22	2.0	3.0	5.1	2.1	2.0	3.8	.9	2.8	.....	.1	1.8	1.9
23	2.0	3.0	4.2	2.1	4.9	2.9	1.0	2.6	.....	.2	1.8	1.8
24	2.0	3.0	3.9	3.0	5.0	2.8	4.9	2.0	.....	.3	1.7	1.8
25	2.0	3.0	2.1	3.1	5.1	1.8	7.2	1.6	.....	.3	1.6	1.8
26	2.0	4.2	2.1	4.0	4.0	1.6	9.4	1.2	.....	.3	1.6	1.8
27	2.0	4.5	2.1	5.5	5.6	1.5	13.7	1.2	.....	.3	1.6	1.8
28	2.0	4.4	2.1	6.5	6.0	1.5	18.3	1.2	.....	.2	3.1	1.8
29	2.0	.....	2.1	6.6	5.6	1.5	17.2	1.2	.....	.2	3.5	1.8
30	2.0	.....	2.1	6.0	5.5	4.5	13.2	1.2	.....	.2	3.4	1.7
31	2.0	.....	2.0	.....	5.5	.....	10.2	1.2	.....	.2	.....	1.7

Station rating table for Pecos River, near Pecos, Tex., from January 1 to July 24, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	140	2.20	375	3.50	835	4.80	1,535
1.00	150	2.30	400	3.60	880	4.90	1,600
1.10	160	2.40	430	3.70	925	5.00	1,665
1.20	170	2.50	460	3.80	975	5.20	1,795
1.30	185	2.60	490	3.90	1,025	5.40	1,935
1.40	200	2.70	525	4.00	1,080	5.60	2,075
1.50	220	2.80	560	4.10	1,135	5.80	2,220
1.60	240	2.90	595	4.20	1,190	6.00	2,370
1.70	260	3.00	630	4.30	1,245	6.20	2,530
1.80	280	3.10	670	4.40	1,300	6.40	2,690
1.90	300	3.20	710	4.50	1,355	6.60	2,850
2.00	325	3.30	750	4.60	1,415		
2.10	350	3.40	790	4.70	1,475		

The above table is based on four discharge measurements made during 1905. It is no twell defined.

Station rating table for Pecos River, near Pecos, Tex., from July 25 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.10	115	1.30	465	2.50	955	3.70	1,640
.20	135	1.40	500	2.60	1,000	3.80	1,715
.30	155	1.50	535	2.70	1,050	3.90	1,790
.40	180	1.60	570	2.80	1,100	4.00	1,865
.50	205	1.70	610	2.90	1,150	4.20	2,030
.60	235	1.80	650	3.00	1,200	4.40	2,210
.70	265	1.90	690	3.10	1,250	4.60	2,390
.80	295	2.00	730	3.20	1,305	4.80	2,580
.90	325	2.10	775	3.30	1,365	5.00	2,780
1.00	360	2.20	820	3.40	1,430		
1.10	395	2.30	865	3.50	1,500		
1.20	430	2.40	910	3.60	1,570		

The above table is based on 13 discharge measurements made during 1905. It is well defined between gage heights 0.1 foot and 3.2 feet. Above gage height 3.2 feet it is based on three slope measurements.

Estimated monthly discharge of Pecos River, near Pecos, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	350	325	340	20,910
February	1,355	465	682	37,880
March	2,850	325	1,372	84,360
April	2,850	160	596	35,460
May	2,470	150	1,091	67,080
June	2,530	220	1,243	73,960
July	25,500	140	3,548	218,200
August	5,800	430	1,664	102,300
September [a]	.....	.....	.....	.....
October 6–31	530	115	189	9,747
November	1,500	130	592	35,230
December	1,100	615	764	46,980
The period	.....	.....	.....	732,100

[a] No estimate.

NOTE.—For discharge of flume of Barstow Irrigation Company see following pages.

Discharge measurements of flume of Barstow Irrigation Company near Pecos, Tex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 10	Murphy and Giles	20.5	33	7.83	1.70	257
July 11	J. M. Giles	20.5	17.4	5.86	1.10	102
July 11	do	20.5	17.4	5.91	1.10	103
July 14	E. Patterson	20.5	18.5	6.21	1.15	115
September 14	do	20.5	26.6	7.07	1.40	188
October 6	J. M. Giles	20.5	29	7.62	1.60	219
October 7	do	20.5	27	7.57	1.50	202
October 16	E. Patterson	20.5	24	7.11	1.30	168
October 20	do	20.5	23	7.01	1.25	158
November 8	do	20.5	27	7.30	1.40	194
November 8 [a]	do	20.5	35	4.25	1.70	148
November 16	J. M. Giles	20.5	26.6	4.97	1.30	132
November 16 [a]	do	20.5	14	2.29	.80	32
December 6	E. Patterson	20.5	13.3	1.57	.65	21

[a] At lower end of flume.

Daily gage height, in feet, of flume of Barstow Irrigation Company near Pecos, Tex., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.0	1.8	1.8	1.6				1.3	0.8
2		1.0	1.8	1.8	1.0				1.3	.8
3		1.0	1.8	1.6	1.0				1.3	.8
4		1.0	1.8	1.6	1.0				1.3	.8
5		1.0	1.8	1.8	1.0				1.5	.8
6		1.0	1.8	1.8	1.0			1.6	1.5	.8
7		.9	1.8	1.9	1.0			1.5	1.5	.7
8		1.0	1.8	1.9	1.0			1.4	1.5	.7
9		1.1	1.8	1.9	1.0			1.4	1.5	.7
10		1.3	1.8	1.9	1.1		1.5	1.4	1.5	.7
11		1.4	1.8	1.9	1.3		1.5	1.3	1.5	.7
12	1.1	1.6	1.9	1.9	1.3		1.5	1.3	1.5	.7
13	1.1	1.8	1.9	1.6	1.05		1.5	1.3	1.5	.7
14	1.1	1.8	1.8	1.6	1.5		1.4	1.3	1.5	.6
15	1.1	1.8	1.8	1.6	1.6		1.4	1.3	1.3	.6
16	1.1	1.9	1.8	1.6	1.6		1.4	1.3	1.3	.6
17	1.1	1.9	1.8	1.6	1.6			1.3	.8	.6
18	1.1	1.8	1.8	1.6	1.6			1.3	.8	.6
19	1.1	1.8	1.8	1.6	1.4			1.3	.8	.6
20	1.2	1.8	1.8	1.8	1.3			1.3	.8	.6
21	1.3	1.8	1.8	1.8	1.3			1.3	.8	.6
22	1.3	1.8	1.9	1.7	1.3			1.3	.8	.6
23	1.3	1.8	1.8	1.7	1.5			1.3	.8	.6
24	1.3	1.8	1.8	1.7	1.6			1.3	.8	.6
25	1.3	1.8	1.8	1.7	1.8			1.4	.8	.6
26	1.3	1.8	1.8	1.7	1.6			1.3	.8	.6
27	1.3	1.8	1.9	1.7	2.4			1.3	.8	.6
28	1.3	1.8	1.8	1.7	2.65			1.3	.8	.6
29	1.3	1.8	1.8	1.7	2.35			1.3	.8	.6
30	1.3	1.8	1.8	2.0	1.25			1.3	.8	.6
31	1.3		1.8		.6			1.3		.6

NOTE.—November 1-16 water was being wasted from flume into river; hence gage heights at upper end of flume did not represent flow accurately.

Station rating table for flume of the Barstow Irrigation Company near Pecos, Tex., from March 12 to November 16, 1905.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	10	1.00	80	1.40	179	1.80	285
0.70	22	1.10	103	1.50	205	1.90	312
0.80	38	1.20	128	1.60	231	2.00	340
0.90	57	1.30	153	1.70	258		

[a] Not strictly applicable November 1-16, during which time water was being wasted from flume into river; hence gage heights at upper end of flume did not represent flow accurately.

The above table is based on 13 discharge measurements made during 1905. It is fairly well defined between gage heights 1.1 feet and 1.7 feet.

Estimated monthly discharge of flume of Barstow Irrigation Company near Pecos, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 12-31	153	103	132	5,237
April	312	57	216	12,850
May	312	285	288	17,710
June	340	231	269	16,010
July	522	10	182	11,190
September 10-16	205	179	194	2,694
October 6-31	231	153	162	8,355
The period				74,050

PECOS RIVER NEAR MOORHEAD, TEX.

This station was established by the International (Water) Boundary Commission in April, 1900. It is near Moorhead, immediately above the high bridge of the Southern Pacific Railroad.

The station is in the bottom of a canyon about 300 feet deep. The river is straight for a mile or more both above and below the station. Both banks are of rock, but the bottom of the stream is mud. The river here consists of a series of pools connected by rapids. The best pool was chosen for the station.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the cable support on the left bank.

The gage is a scantling bolted to one of the piers of the bridge. Its painted face is read from the top of the cliff with the aid of field glasses. The highest known flood occurred April 6, 1900, about two weeks before this gage was established. The water marks showed that it reached 35.75 feet on the gage. The range between high and low water is 35 feet. The bench mark is a cross cut on solid rock above a spring about 600 feet above the bridge: elevation, 27.08 above the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is E. E. Winter and the gage reader is the section foreman for the railroad.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 50, p 362; 66, p 77; 84, p 166; 99, p 351; 132, p 109.
Discharge: 50, p 363; 66, p 78; 84, pp 166-167; 99, pp 352-353; 132, pp 109-111.
Discharge, mean daily: 132, p 113.
Discharge, monthly: 75, p 160; 84, p 168; 99, p 354; 132, p 114.
Gage heights: 50, p 363; 66, p 78; 84, p 167; 99, p 354; 132, p 112.

Discharge measurements of Pecos River near Moorhead, Tex., in 1905.

Date.	Hpdrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 3	E. E. Winter	773	0.98	1.75	758
January 7	do	774	.95	1.75	735
January 12	do	762	.80	1.65	611
January 16	do	756	.80	1.6	604
January 20	do	755	.74	1.5	557
January 24	do	724	.73	1.5	531
January 29	do	726	.73	1.5	532
February 3	do	762	.91	1.7	694
February 7	do	760	.93	1.75	710
February 11	do	775	1.02	2.0	787
February 15	do	790	1.03	2.0	811
February 20	do	807	1.07	2.2	861
February 23	do	782	1.01	2.1	791
February 26	do	795	1.01	2.05	806
March 8	do	924	1.97	3.4	1,817
March 11	do	849	1.39	2.7	1,180
March 16	do	893	1.72	3.2	1,532
March 20	do	1,004	2.20	3.7	2,212
March 24	do	824	1.26	2.4	1,041
March 29	do	770	1.03	2.1	795
April 4	do	861	1.18	2.5	1,018
April 8	do	821	.98	2.0	805
April 12	do	827	.93	1.9	772
April 17	do	790	.90	1.7	709
April 21	do	785	.89	1.6	702
April 25	do	921	1.47	3.0	1,356
April 28	do	845	1.01	2.2	854
May 3	do	1,023	2.24	3.5	2,288
May 8	do	1,000	2.16	3.4	2,155
May 11	do	981	1.62	3.1	1,594
May 16	do	1,010	2.02	3.4	2,040
May 20	do	883	1.12	2.2	991
May 24	do	950	1.72	2.8	1,633
May 29	do	883	1.13	2.2	999
June 3	do	1,011	1.61	3.2	1,623
June 9	do	948	1.23	2.6	1,166
June 12	do	857	.84	1.9	720
June 17	do	1,037	2.24	3.5	2,324
June 21	do	1,004	2.07	3.4	2,078
June 24	do	1,010	2.00	3.3	2,025
July 2	do	898	1.17	2.2	1,050
July 7	do	1,015	1.44	3.1	1,459
July 13	do	907	1.04	2.1	942
July 18	do	867	.85	2.0	734
July 23	do	874	.85	2.0	739

Discharge measurements of Pecos River near Moorhead, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
July 28	E. E. Winter	768	0.83	1.65	639
August 6	do	1,104	3.20	4.3	3,528
August 10	do	1,208	3.92	5.2	4,733
August 15	do	956	2.57	3.35	2,459
August 20	do	899	1.69	2.8	1,521
August 24	do	906	1.51	2.6	1,367
August 30	do	894	1.33	2.4	1,186
September 6	do	782	.96	1.9	753
September 11	do	775	.89	1.8	689
September 14	do	785	.93	2.0	728
September 22	do	803	1.08	2.2	870
September 25	do	774	.96	2.0	740
September 28	do	791	.97	1.9	767
October 3	do	774	.81	1.7	628
October 7	do	793	.91	1.9	719
October 10	do	803	.94	1.9	753
October 15	do	780	.84	1.75	652
October 20	do	774	.78	1.6	577
October 24	do	729	.73	1.5	531
October 29	do	724	.71	1.5	514
November 3	do	704	.72	1.4	510
November 7	do	707	.71	1.4	503
November 10	do	711	.71	1.4	505
November 14	do	743	.86	1.7	637
November 18	do	716	.75	1.6	534
November 22	do	792	1.12	2.2	886
November 25	do	783	1.12	2.2	875
December 2	H. F. Collins	772	1.15	2.0	890
December 8	do	827	1.53	2.4	1,267
December 13	do	831	1.51	2.4	1,257
December 22	do	805	1.52	2.3	1,227
December 25	do	788	1.44	2.3	1,138
December 29	do	783	1.45	2.2	1,138

Daily gage height, in feet, of Pecos River near Moorhead, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.75	1.6	2.05	6.7	2.6	3.0	2.2	3.5	2.4	1.8	1.4	2.0
2	1.75	1.65	2.1	3.75	2.6	3.15	2.2	3.55	2.35	1.7	1.4	2.0
3	1.75	1.7	2.15	3.0	3.45	3.2	2.3	3.8	2.45	1.7	1.4	2.2
4	1.75	1.7	2.2	2.5	3.5	3.2	2.65	3.9	2.45	1.8	1.4	2.65
5	1.75	1.7	2.25	2.3	3.55	3.2	2.35	4.1	2.25	1.8	1.35	2.7
6	1.75	1.75	2.3	2.2	3.6	3.2	2.3	4.15	1.95	1.85	1.35	2.6
7	1.75	1.75	2.4	2.1	3.55	3.2	3.1	4.55	1.9	1.9	1.4	2.55
8	1.7	1.8	3.45	2.0	3.4	3.05	4.1	4.85	1.95	1.9	1.4	2.4
9	1.7	1.85	2.75	2.0	3.35	2.65	4.4	4.9	1.9	2.0	1.4	2.4
10	1.7	1.9	2.6	2.0	3.2	2.05	3.55	5.1	1.9	1.95	1.4	2.45
11	1.65	2.0	2.65	2.0	3.15	2.0	2.7	5.5	2.0	1.8	1.6	2.5
12	1.65	2.0	2.6	1.9	3.1	1.9	2.35	5.6	1.8	1.8	1.7	2.45
13	1.65	2.0	2.6	1.9	3.1	1.75	2.1	5.4	1.9	1.75	1.7	2.4
14	1.6	2.0	2.6	1.85	3.2	1.7	2.0	4.9	2.05	1.75	1.8	2.4
15	1.55	2.0	5.2	1.8	3.2	2.15	2.0	3.6	2.65	1.75	1.8	2.4
16	1.5	2.0	3.25	1.7	3.4	3.0	2.0	3.5	2.9	1.75	1.8	2.3
17	1.5	2.1	3.2	1.7	3.3	3.45	2.0	3.25	2.75	1.7	1.8	2.3
18	1.5	2.15	3.35	1.7	3.15	3.5	2.0	3.0	2.4	1.65	1.7	2.3
19	1.45	2.2	3.55	1.7	2.8	3.5	2.0	2.8	2.3	1.65	2.0	2.3
20	1.45	2.2	3.7	1.6	2.25	3.5	2.0	2.8	2.3	1.6	2.1	2.3
21	1.45	2.2	3.2	1.6	2.35	3.4	2.1	2.8	2.2	1.55	2.2	2.3
22	1.45	2.1	2.85	1.6	2.75	3.4	2.0	2.7	2.2	1.5	2.2	2.3
23	1.45	2.1	2.65	8.95	2.7	3.4	1.95	2.6	2.2	1.5	2.2	2.3
24	1.5	2.1	2.45	3.05	2.8	3.2	1.7	2.6	2.2	1.5	2.2	2.3
25	1.5	2.05	2.25	2.95	2.85	3.05	1.7	2.6	2.05	1.5	2.2	2.3
26	1.5	2.05	2.7	2.7	2.55	2.9	1.6	2.5	2.0	1.5	2.1	2.3
27	1.5	2.05	2.7	2.25	2.4	2.65	1.65	2.5	2.0	1.45	2.1	2.3
28	1.5	2.0	2.5	2.2	2.4	2.95	1.65	2.5	1.95	1.45	2.1	2.2
29	1.55	.....	2.25	3.2	2.25	6.05	1.75	2.45	1.95	1.5	2.1	2.2
30	1.55	.....	2.05	2.65	2.6	2.25	3.1	2.4	1.9	1.45	2.0	2.1
31	1.45	.....	2.0	.....	2.9	.....	3.2	2.4	.....	1.45	.....	2.1

Daily discharge, in second-feet, of Pecos River near Moorhead, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	700	625	805	8,950	1,100	1,700	1,050	2,090	1,190	700	470	830
2	730	660	845	2,070	1,100	1,690	[a]1,050	2,180	1,140	630	490	[a]890
3	[a]760	[a]695	880	1,320	[a]2,220	[a]1,620	1,095	2,630	1,230	[a]630	[a]510	1,080
4	750	695	920	[a]1,020	2,290	1,620	1,250	2,810	1,230	675	510	1,500
5	745	695	955	935	2,360	1,620	1,115	3,170	1,060	675	490	1,550
6	740	710	990	890	2,430	1,620	1,095	[a]3,260	[a]800	695	490	1,460
7	[a]735	[a]710	1,065	845	2,360	1,620	[a]1,460	3,860	750	[a]720	[a]505	1,410
8	670	725	[a]1,855	[a]805	[a]2,150	1,500	2,460	4,270	780	730	505	[a]1,270
9	670	740	1,225	805	2,060	[a]1,200	2,760	4,330	750	805	505	1,270
10	670	755	1,090	805	1,780	810	1,910	[a]4,600	750	[a]785	[a]505	1,320
11	610	[a]785	[a]1,135	805	[a]1,680	780	1,250	5,330	[a]790	685	590	1,360
12	[a]610	790	1,110	[a]770	1,590	[a]720	1,070	5,530	690	685	635	1,310
13	610	795	1,110	770	1,590	640	[a]940	5,260	710	650	635	[a]1,260
14	605	800	1,110	755	1,740	620	850	4,580	[a]760	650	[a]680	1,260
15	580	[a]810	5,220	740	1,740	890	820	[a]2,810	1,320	[a]650	660	1,260
16	[a]560	810	[a]1,560	710	[a]2,040	1,740	790	2,710	1,570	650	645	1,230
17	560	835	1,530	[a]710	1,950	[a]2,260	760	2,290	1,420	625	630	1,230
18	560	850	1,735	715	1,820	2,280	[a]735	1,860	1,070	600	[a]575	1,230
19	540	860	2,005	720	1,510	2,240	735	1,520	970	600	760	1,230
20	[a]530	[a]860	[a]2,210	700	[a]1,040	2,210	740	[a]1,520	970	[a]575	820	1,230
21	520	860	1,760	[a]700	1,150	[a]2,080	800	1,520	870	550	880	1,230
22	515	790	1,445	700	1,580	2,080	740	1,440	[a]870	530	[a]885	[a]1,230
23	510	[a]790	1,265	14,570	1,520	2,080	[a]725	1,370	870	530	880	1,200
24	[a]530	805	[a]1,085	1,390	[a]1,630	[a]1,930	650	[a]1,370	870	[a]530	880	1,170
25	530	790	915	[a]1,320	1,690	1,780	650	1,370	[a]770	530	[a]875	[a]1,140
26	530	[a]805	1,310	1,170	1,370	1,630	625	1,280	770	525	825	1,160
27	530	805	1,310	885	1,210	1,380	640	1,280	800	500	825	1,180
28	530	775	1,130	[a]855	1,210	[a]1,680	[a]640	1,280	[a]800	495	825	1,120
29	[a]550	.....	[a]915	1,480	[a]1,050	7,300	670	1,230	800	[a]515	825	[a]1,140
30	550	.....	755	1,140	1,420	1,040	1,460	[a]1,190	765	490	775	1,040
31	510	.....	715	.....	1,740	.....	1,560	1,190	.....	490	.....	1,020

[a] Meter measurements.

Estimated monthly discharge of Pecos River, near Moorhead, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	760	510	605	37,170
February	860	625	772	42,893
March	5,220	715	1,354	83,226
April	14,570	700	1,668	99,273
May	2,430	1,040	1,681	103,379
June	7,300	620	1,745	103,855
July	2,760	625	1,068	65,643
August	5,530	1,190	2,617	160,919
September	1,570	690	938	55,805
October	805	490	616	37,884
November	885	470	670	39,838
December	1,550	830	1,220	74,995
The year	14,570	470	1,246	904,880

GALLINAS RIVER NEAR LAS VEGAS, N. MEX.

This station was established August 13, 1903, by E. G. Marsh. It is located at Las Vegas Hot Springs, 6 miles above Las Vegas, N. Mex. The establishment of this station was primarily for the purpose of determining the amount of water available for diversion and storage in the San Guyjuella basin about 6 miles northwest of Las Vegas.

The channel is straight for 50 feet above and 100 feet below the station. The bed is composed of bowlders with a loose deposit of sand and gravel during low water. The right bank is a vertical wall protecting the power house. The left bank is a vertical wall composed of bowlders embedded in binding material. There is but one channel at all stages. The velocity is moderate at low water and very swift during high water.

Discharge measurements are made from a single-span wooden bridge at the power house during high water; at low water discharge measurements are made at the same section by wading.

The original gage was bolted to the masonry wall on the right bank which protects Hot Springs Nos. 16 and 17. These springs are located about 300 feet above the power house and bridge from which discharge measurements are made. The gage was washed out by the flood of September 29, 1904, and was replaced by a similar rod October 19, 1904. The zero of the new rod is 0.71 foot lower than the zero of the old rod. During 1905 the gage was read twice each day by William Prager, except when rapid fluctuations make more frequent observations necessary. The bench mark is a leaded bolt in a granite outcropping on the right (south) bank of the river 200 feet above the gage rod; elevation, 19.17 feet above the datum of the new gage. The 7-foot mark on this gage is identical with the upper surface of the masonry wall to which it is attached.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 253; 132, pp 116–117.
Discharge: 99, p 254; 132, p 117.
Gage heights: 99, p 254; 132, p 118.

Discharge measurements of Gallinas River near Las Vegas, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 5 [a]	R. I. Meeker	17	20	0.45	1.80	9
April 27 [b]	do	50	78	4.19	3.10	327
May 27 [b]	Meeker and Murphy	42	54	3.02	2.65	163
July 1 [a]	R. I. Meeker	24	23	1.04	1.90	24
August 2 [a]	do	24	25	1.20	2.00	30

[a] Made by wading under foot bridge. [b] Made from Hot Springs bridge.

Daily gage height, in feet, of Gallinas River near Las Vegas, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	1.8	2.2	2.3	3.1	2.5	1.9	2.05	1.8	1.8	1.6	2.0
2	1.8	1.8	2.8	2.3	3.2	2.45	1.9	2.1	1.8	1.8	1.6	1.8
3	1.8	1.8	2.6	2.4	3.1	2.4	1.9	1.95	1.8	1.8	1.6	1.8
4	1.8	1.8	2.45	2.5	2.95	2.45	1.8	1.9	1.85	1.8	1.6	2.0
5	1.8	1.8	2.5	2.5	2.85	2.4	1.8	2.13	1.8	1.7	1.6	2.0
6	1.8	1.8	2.6	2.5	2.8	2.3	1.8	2.1	1.8	1.6	1.6	1.8
7	1.8	1.8	2.6	2.5	2.75	2.3	1.8	2.3	1.85	1.6	1.6	1.8
8	1.8	1.8	2.5	2.6	2.8	2.65	1.8	2.2	1.8	1.6	1.6	1.8
9	1.8	1.8	2.5	2.6	2.95	2.5	1.8	2.1	1.85	1.65	1.6	1.8
10	1.8	1.8	2.5	2.6	2.85	2.45	1.8	2.1	1.9	1.6	1.6	1.8
11	1.8	1.8	2.4	2.6	2.8	2.4	1.8	2.1	1.8	1.6	1.6	1.95
12	1.8	1.8	2.3	2.6	2.75	2.3	1.8	2.1	1.8	1.6	1.6	2.0
13	1.8	1.8	2.3	2.55	2.75	2.3	1.8	2.05	1.8	1.6	1.6	2.0
14	1.8	1.8	2.3	2.5	2.7	2.25	1.8	2.0	1.8	1.6	1.6	1.85
15	1.8	1.85	2.4	2.5	2.7	2.2	1.8	1.9	1.8	1.6	1.6	1.9
16	1.8	1.8	2.4	2.5	2.75	2.15	1.8	1.9	1.8	1.6	1.8	1.9
17	1.8	1.8	2.4	2.5	2.8	2.1	1.8	1.9	1.8	1.6	1.75	1.9
18	1.8	1.8	2.3	2.5	2.9	2.1	1.8	1.9	1.8	1.6	1.6	1.85
19	1.8	1.85	2.3	2.5	2.8	2.1	1.8	1.9	1.8	1.6	1.8	1.85
20	1.8	1.8	2.3	2.5	2.8	2.0	1.8	1.9	1.8	1.6	1.8	1.85
21	1.8	1.85	2.2	2.5	2.8	2.05	1.8	1.8	1.7	1.6	1.8	1.8
22	1.8	2.0	2.2	2.5	2.8	2.0	2.0	1.8	1.7	1.6	2.0	1.8
23	1.8	2.3	2.2	2.9	2.7	2.0	2.01	1.8	1.7	1.6	2.35	1.8
24	1.8	2.7	2.2	3.2	2.65	2.0	2.0	1.8	1.7	1.6	2.05	1.9
25	1.8	2.65	2.2	3.15	2.6	1.95	1.9	1.8	1.8	1.6	2.0	1.9
26	1.8	2.7	2.25	3.05	2.6	1.9	1.9	1.8	2.2	1.6	2.0	1.9
27	1.8	2.7	2.35	3.1	2.6	1.9	1.8	1.8	1.9	1.6	3.05	1.9
28	1.8	2.2	2.4	3.2	2.55	1.9	1.8	1.8	1.9	1.6	2.8	1.9
29	1.8	.....	2.3	3.1	2.5	1.9	1.8	1.8	1.85	1.6	2.35	1.9
30	1.8	.....	2.25	3.0	2.5	1.9	1.8	1.8	1.8	1.6	2.2	1.9
31	1.8	.....	2.25	.....	2.5	.....	2.3	1.8	.....	1.6	.....	1.9

Station rating table for Gallinas River near Las Vegas, N. Mex., from October 8, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	2	2.10	42	2.60	148	3.10	330
1.70	6	2.20	57	2.70	178	3.20	380
1.80	12	2.30	75	2.80	210		
1.90	20	2.40	97	2.90	245		
2.00	30	2.50	121	3.00	285		

The above table is based on five discharge measurements made during 1905. It is well defined.

Estimated monthly discharge of Gallinas River near Las Vegas, N. Mex., for 1904–1905.

[Drainage area, 90 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
October 8–31	210	2	32.6	1,551	0.362	0.323
November	57	4	13.7	815	.152	.170
December	20	2	10.2	627	.113	.130
1905.						
January	12	12	12.0	738	.133	.153
February	178	12	40.1	2,227	.446	.464
March	210	57	93.3	5,737	1.04	.120
April	380	75	177	10,530	1.97	2.20
May	380	121	206	12,670	2.29	2.64
June	163	20	63.4	3,773	.704	.786
July	75	12	17.1	1,051	.190	.219
August	75	12	26.7	1,642	.297	.342
September	57	6	14.0	833	.156	.174
October	12	2	3.5	215	.039	.045
November	308	2	32.1	1,910	.357	.398
December	30	12	18.7	1,150	.208	.240
The year	380	2	57.8	42,480	.652	7.78

NOTE.—From January 1 to September 27, 1904, the discharge was practically nothing, the water not being sufficient for current meter measurements. Discharge from September 29 to October 7, 1904, inclusive, was 16,570 acre-feet. Taken from G. B. Monk's report of floods in northern New Mexico in 1904. See also Water-Supply Paper No 147, Destructive Floods in United States in 1904, by E. C. Murphy.

HONDO RIVER AT ROSWELL, N. MEX.

This station was established April 25, 1903, by W. M. Reed. It is located at the bridge at the intersection of Main and Vegas streets, Roswell, N. Mex.

The channel is nearly straight for 50 feet above and 450 feet below the bridge and has a width at ordinary high stages of 40 feet. The current has a moderate velocity. Both banks are low and overgrown with weeds, but are not liable to overflow. The bed of the stream is sandy loam, fairly permanent, and free from vegetation. There is but one channel at all stages.

Discharge measurements are made from the highway bridge. The initial point for soundings is a zero marked on the east stringer at the north end of the bridge.

In July, 1905, the channel of the river was widened at the street crossing and the original gage was torn out by the workman. August 8, 1905, a new inclined gage was placed on the left bank at the upstream side of bridge. It consists of a timber spiked to stakes driven in the bank, and the upper end is bolted to a sill of the bridge. During 1905 the gage was read by members of the Geological Survey office force at Roswell. Bench marks were established as follows: (1) The top of eyebar on west side of bridge; elevation, 7.45 feet. (2) The southeast corner of the cement sidewalk 25 feet northwest of bridge; elevation, 7.82 feet. (3) The top step near stone column at the entrance to the office of the Pecos Valley Lumber Company; elevation, 3.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers the United States Geological Survey:

Description: 99, pp 361-362; 132, pp 118-119.
Discharge: 99, p 362; 132, p 119.
Gage heights: 99, p 362; 132, p 119.

Discharge measurements of Hondo River at Roswell, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 13	J. M. Giles	11	6	1.07	0.10	6
April 25	E. Patterson	26	93	3.71	5.20	345
April 25	do	27	102	3.74	5.60	383
April 25	W. A. Wilson		98	4.36	6.00	429
April 26	E. Patterson	26	84	3.62	4.80	306
April 26	do	24	77	3.53	4.50	271
April 26	do	26	88	4.03	4.95	356
April 27	do	24	69	3.00	4.20	206
May 13	do	14	27	2.92	1.75	78
May 17	J. M. Giles	14	15	2.51	1.10	38
July 24	E. Patterson	30	131	4.20	5.00	551
July 24	do	24	82	3.79	3.20	311
July 25	do	30	134	4.09	5.00	550
July 26	do	32	159	4.27	5.90	682
July 26	do	32	156	4.15	5.60	648
July 27	do	30	125	3.95	4.75	495
July 28	do	27	110	3.72	4.00	409
July 31	do	22	49	3.41	2.00	166
August 2	J. M. Giles	24	65	3.59	2.50	234
August 2	do	20	54	3.10	1.85	169
August 8	E. Patterson	21	50	3.83	2.10	192
August 15	do	19	32	3.61	1.50	116
August 26	do	13	10	2.18	− .10	22
August 28	do	4	2	.64	−1.10	1.2
September 8	do	8	3	.93	− .90	3
September 11	do	14	23	2.94	.75	68
October 4	do	8	1.6	.71	−1.00	1.2
November 10	do		22	2.42	.80	52
November 29	do		103	3.82	3.95	394
December 3	do		36	3.50	1.35	124
December 9	do	21	20	2.58	.40	51
December 23	do	20	15	2.47	.20	36

HONDO RIVER AT HONDO RESERVOIR SITE, NEW MEXICO.

This station was established March 9, 1903, by W. A. Wilson. It is located at the first New Mexico reservoir dam site, 12 miles southwest of Roswell, N. Mex.

The channel is straight for 200 feet above and below the station. The current is swift at high water and sluggish at low water. Both banks are high, without trees, and liable to overflow. There is but one channel at all stages. The bed is composed of shifting sand and the cross section changes during each flood.

A footbridge has been constructed 75 feet below the dam, for the purpose of making discharge measurements. The initial point for soundings is 1 foot south of the north end of the west stringer of the bridge.

The gage is a vertical timber located 10 feet north of the footbridge. During 1905 the gage was read twice each day by Lee Hall. The bench-mark is on a ledge of rock which

bears S. 45° W., and is 650 feet distant from the gage; elevation, 19.10 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 362; 132, pp 119-120.
Discharge: 99, p 363; 132, p 120.
Gage heights: 99, p 363; 132, p 121.

Discharge measurements of Hondo River at Hondo reservoir site, New Mexico, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 24	H. C. Hurd	23	26	3.77	3.25	96
February 26	H. L. Eames	23	48	3.84	4.35	184
March 3	do	24	58	6.95	5.70	400
March 5	do	24	74	7.26	6.58	536
March 8	do	24	62	7.07	6.00	436
March 15	do	23	37	4.45	4.85	166
March 24	do	24	34	2.33	3.38	78
March 25	do	24	28	2.34	3.20	66
March 27	do	24	31	2.04	3.10	63
March 29	do	24	32	2.39	3.20	77
April 1	do	24	29	2.17	2.90	62
April 6	do	18	18	1.88	2.30	33
April 10	do	15	9.5	1.31	1.77	12
April 14	Giles and Eames	24	32	2.20	2.90	71
April 25	H. L. Eames	30	205	7.05	9.80	1,446
April 29	do	25	170	6.83	8.40	1,158
May 18	J. M. Giles		45	2.32	3.22	105
July 26	E. Patterson	31	177	4.28	9.70	758
July 29	do	25	125	5.73	7.80	714
August 2	do	23	33	4.01	3.60	132
August 7	do	23	39	4.80	3.80	188
August 10	do	23	51	5.60	5.40	285
August 29	do	23	14	1.91	3.30	26
September 10	do		13	2.54	3.40	33
September 16	J. M. Giles		11	1.72	3.20	19
October 5	E. Patterson	20	9	1.96	3.12	18
October 14	do	12	6	1.09	2.95	7
October 14	J. M. Giles	11	7.2	1.47	2.97	10.6
October 24	E. Patterson	14	7	1.65	3.10	11.6
November 29	do		106	5.23	8.00	556
December 1	do		44	5.27	5.35	232
December 26	do				5.00	[a] 20

[a] Estimated through ice and snow.

Daily gage height, in feet, of Hondo River at Hondo reservoir site, New Mexico, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.95	.....	4.6	2.9	7.5	1.45	.....	6.55	2.9	3.1	3.1	5.35
2	.9	.....	5.0	2.8	7.95	2.05	4.3	3.75	2.9	3.2	3.05	4.9
3	.9	.....	5.7	2.65	8.0	1.75	4.0	7.9	2.8	3.25	3.0	4.55
4	.9	.....	6.65	2.6	7.3	1.75	3.9	4.5	3.15	3.25	3.0	4.4
5	.9	.....	6.6	2.4	6.85	2.0	3.8	3.95	3.25	3.1	3.0	4.05
6	.85	.....	6.2	2.3	6.35	1.8	.....	3.85	3.7	3.1	3.15	3.85
7	.9	.....	6.05	2.1	5.85	1.85	.....	4.1	3.4	3.05	3.35	3.6
8	.95	.....	5.9	1.95	5.45	1.7	.....	4.3	3.45	3.0	3.3	3.1
9	.85	.....	5.55	1.8	4.95	7.8	.....	6.75	3.35	3.0	3.45	3.3
10	.85	.....	5.25	1.9	5.0	7.95	.....	5.6	3.6	3.0	3.8	3.4
11	.9	.....	5.1	2.25	4.55	7.45	.....	5.85	3.95	3.0	3.85	3.35
12	2.3	.....	4.95	2.95	4.05	10.5	.....	7.05	3.5	3.0	3.8	3.4
13	1.9	.....	4.9	2.95	3.75	5.95	.....	4.7	3.3	3.0	3.65	3.4
14	1.65	.....	4.75	2.75	3.6	5.25	.....	5.4	3.2	3.0	3.65	3.35
15	1.55	.....	4.8	2.55	3.55	5.15	.....	5.05	3.2	2.9	3.5	3.2
16	1.55	.....	4.6	2.35	3.25	5.15	.....	5.3	3.15	2.9	3.45	3.1
17	1.5	.....	4.6	2.4	3.0	5.1	.....	4.65	3.05	3.0	3.4	3.1
18	1.4	.....	4.5	2.3	3.05	5.1	.....	4.4	3.05	2.9	3.3	3.0
19	1.3	.....	4.35	2.5	3.05	4.9	.....	4.15	2.95	2.95	3.35	3.0
20	1.3	2.65	4.1	2.85	3.15	4.9	.....	4.0	2.9	2.95	3.35	2.9
21	1.7	2.75	3.9	3.05	4.1	4.8	.....	3.95	2.95	3.0	3.35	2.9
22	1.2	2.95	3.75	2.75	3.55	4.7	.....	3.85	2.55	3.0	3.35	3.0
23	1.2	3.05	3.55	3.1	3.1	4.7	6.3	4.2	2.85	3.05	3.45	3.2
24	.....	3.25	3.3	3.2	2.9	4.55	8.05	4.2	2.9	3.05	3.3	4.0
25	.....	4.25	3.2	9.1	2.65	4.4	11.4	3.9	2.75	3.15	3.3	4.3
26	.....	4.25	3.1	7.4	2.55	4.35	9.2	3.6	3.65	3.1	3.3	4.7
27	.....	4.4	3.1	7.95	2.4	4.15	8.55	3.2	3.4	3.1	3.25	4.35
28	.....	4.6	3.15	8.8	2.25	3.9	7.0	3.2	3.6	3.05	6.7	4.2
29	.....	.....	3.2	8.45	2.15	3.75	6.5	3.15	3.45	3.1	8.7	4.5
30	.....	.....	3.2	8.25	2.05	.....	4.15	3.15	3.2	3.0	6.0	4.5
31	.....	.....	2.6	.....	1.75	.....	4.35	3.15	.....	3.05	.....	4.8

NOTE.—River dry on days of no gage height.

TAYLOR-MOORE DITCH NEAR ROSWELL, N. MEX.

This station was established March 23, 1905, and discontinued June 8, 1905. It is located between the diversion dam and reservoir site, 12 miles southwest of Roswell. The ditch takes water from Hondo River 2 miles above the Hondo River gaging station.

The channel is straight for 1,000 feet above and below the station and the current is swift. Discharge measurements are made by wading or from a plank thrown across the ditch at the gage. A staff gage is driven into the bank of the ditch. During 1905 the gage was read daily by H. L. Eames.

Discharge measurements of Taylor-Moore ditch near Roswell, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 3	H. L. Eames	7	5.4	3.02	1.45	16.3
April 6	do	7	4.0	2.23	1.20	8.9
April 10	do	7	6.4	3.29	1.62	21.2
April 14	J. M. Giles	7	7.0	3.73	1.72	26.1

Daily gage height, in feet, of Taylor-Moore ditch near Roswell, N. Mex., for 1905.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1	.....	.....	1.6	12	1.71	1.9	.....	23	1.88	1.5	.....
2	.....	.....	1.7	13	1.72	1.9	.....	24	1.9	1.5	.....
3	1.45	.....	1.8	14	1.72	1.9	.....	25	.....	1.4	.....
4	1.47	.....	1.9	15	1.75	1.9	.....	26	.....	1.3	.....
5	1.35	.....	1.9	16	1.72	1.8	.....	27	.....	1.2	.....
6	1.2	.....	1.9	17	1.72	1.81	.....	28	.....	1.15	.....
7	1.0	.....	1.9	18	1.75	1.82	.....	29	.....	1.1	.....
8	1.28	.....	1.9	19	1.78	1.92	.....	30	.....	.7	.....
9	1.6	1.5	.....	20	1.78	1.83	.....	31	.....	1.2	.....
10	1.63	1.92	.....	21	1.82	1.92	.....				
11	1.69	1.91	.....	22	1.84	1.6	.....				

NOTE.—Dam broke April 25; rebuilt May 8. Ditch dry April 25 to May 8. Dam washed out June 9; ditch dry.

Station rating table for Taylor-Moore ditch near Roswell, N. Mex., from March 23 to June 8, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	0.3	1.10	6.7	1.50	17.6	1.90	33
.80	1.7	1.20	8.9	1.60	21.2	2.00	37
.90	3.2	1.30	11.4	1.70	25		
1.00	4.8	1.40	14.4	1.80	29		

The above table is based on four discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 1.7 feet.

Estimated monthly discharge of Taylor-Moore ditch near Roswell, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March 23-31	16	6	12.1	216
April	33	0	17.9	1,065
May	34	0	16.7	1,027
June 1-8	33	21	30.0	476

NOTE.—March 23 to April 2 discharge estimated. Ditch dry April 25 to May 8 and after June 8.

PENASCO RIVER NEAR DAYTON, N. MEX.

This station was established September 12, 1905. It is located about 2 miles east and 1 mile north of Dayton and about 1 mile above the mouth of the river. Both banks are high, but are subject to overflow. The bed of the stream is composed of gravel and is slightly shifting. The current has a good velocity. Discharge measurements are made by wading near the gage.

The gage is in two sections: An inclined scale fastened to stakes driven into the left bank reads from 0 to 5.5 feet. A vertical section nailed to a post at the end of the inclined scale reads from 5.5 to 7.5 feet. During 1905 the gage was read once each day by Eugene Lattion. Bench marks were established as follows: (1) The top of post to which gage is fastened; elevation, 7.38 feet. (2) A nail in post at corner of fence on right bank opposite the gage; elevation, 9.82 feet. Elevations refer to the datum of the gage.

Discharge measurements of Penasco River near Dayton, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
September 12	J. M. Giles	16	7.8	0.95	1.00	7.4
September 15	E. Patterson	8	4.4	1.00	.90	4.4
October 4	J. M. Giles	12	6.8	.68	.95	4.6
October 15	E. Patterson	13	7.7	.70	.95	5.4
November 23	J. M. Giles		52	2.93	1.80	151
November 23	do		34	2.08	1.47	71
November 23	do		21	2.56	1.37	53
November 28	do		22	1.67	1.15	20

Daily gage height, in feet, of Penasco River near Dayton, N. Mex., for 1905.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.9	1.0	1.6	12	1.0	1.0	1.0	1.4	23	.8	1.0	1.55	1.5
2		.9	1.0	1.9	13	.8	1.0	1.0	1.4	24	.9	1.0	1.3	1.5
3		1.0	1.0	1.5	14	.6	1.0	1.0	1.5	25	1.0	1.0	1.2	1.3
4		1.0	1.3	1.6	15	.95	1.0	1.0	1.5	26	.9	1.0	1.2	1.2
5		1.0	1.5	1.6	16	1.0	1.0	1.0	1.5	27	1.0	1.0	1.1	1.4
6		1.0	1.0	1.6	17	1.0	1.0	1.0	1.5	28	.9	1.0	1.8	1.4
7		.9	1.0	1.5	18	1.0	1.0	1.0	1.5	29	.9	1.0	1.7	1.3
8		1.0	1.0	1.5	19	1.0	1.0	1.0	1.5	30	.9	1.0	1.7	1.2
9		1.0	1.0	1.4	20	1.0	1.0	1.0	1.5	31		1.0		1.8
10		1.0	1.0	1.4	21	1.5	1.0	1.0	1.5					
11		1.0	1.0	1.4	22	.9	1.0	1.0	1.5					

Station rating table for Penasco River near Dayton, N. Mex., from September 12, 1905, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	1	1.00	7	1.40	57	1.80	150
.70	2	1.10	15	1.50	77	1.90	180
.80	3	1.20	26	1.60	99		
.90	5	1.30	40	1.70	123		

The above table is based on eight discharge measurements made during 1905. It is well defined between gage heights 0.9 foot and 1.8 feet.

Estimated monthly discharge of Penasco River near Dayton, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
September 12-30	77	1	9.3	351
October	7	5	6.8	418
November	150	7	28.3	1,684
December	180	26	75.3	4,630

DEVILS RIVER AT DEVILS RIVER, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is opposite the Southern Pacific Railroad station at Devils River.

The river is about 50 miles in length, has a perennial flow, and during flood periods is subject to great fluctuations. No good location for a gaging station exists on this stream where it would be accessible from the railroad station. At the site chosen, the river is straight for one-fourth mile both above and below the station. The right bank is the talus of a cliff, the left bank is a bottom heavily timbered. The bed of the stream is nearly all a rock ledge, but seamed and faulted so as to be rough. The currents change in such a way at so give materially different discharges for the same gage height.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the cable support on the left bank.

The gage is a scantling spiked vertically to a tree. The highest water on record occurred April 6, 1900, about two weeks before this gage was established. It reached a height of 25.4 feet on the gage, but this is 8 feet higher than any other known flood. Low water is 2 feet on the gage. The bench mark is a nail in the side of the gate post near the railroad station; elevation, 31.26 feet above the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is E. E. Winter, and the gage reader is John Harrison.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, pp 363-364; 66, p 79; 84, p 164; 99, p 348; 132, p 122.
Discharge: WS 28, p 130; 50, p 364; 66, p 79; 84, p 164; 99, pp 349-350; 132, pp 123-124.
Discharge, mean daily: WS 132, p 125.
Discharge, monthly: Ann 22, iv, p 356; WS 75, p 161; 84, p 165; 99, p 351; 132, p 125.
Gage heights: WS 50, p 364; 66, p 79; 84, p 165; 99, pp 350-351; 132, p 124.

Discharge measurements of Devils River at Devils River, Tex., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
January 9	E. E. Winter	347	1.30	2.3	452
January 17	do	347	1.29	2.3	448
January 25	do	347	1.28	2.3	444
January 30	do	347	1.22	2.25	424
February 8	do	348	1.23	2.3	429
February 16	do	348	1.24	2.3	432
February 27	do	351	1.24	2.3	437
March 13	do	351	1.35	2.35	475
March 17	do	444	1.71	2.6	761
March 21	do	407	1.67	2.5	680
March 25	do	376	1.45	2.4	544
March 30	do	375	1.44	2.4	540
April 5	do	433	1.58	2.65	682
April 13	do	404	1.49	2.5	600
April 18	do	378	1.41	2.4	533
April 25	do	1,079	2.94	4.9	3,168
April 30	do	724	2.18	3.5	1,580
May 4	do	491	1.62	2.8	795
May 12	do	468	1.48	2.7	691
May 17	do	468	1.51	2.7	706
May 25	do	461	1.77	2.7	816
May 30	do	465	2.00	2.7	928
June 5	do	490	1.90	2.8	929

Discharge measurements of Devils River at Devils River, Tex., in 1905—Continued.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Di ch
		Square feet.	*Feet per second.*	*Feet.*	*Sec fe*
June 14	E. E. Winter	461	1.78	2.7	
June 22	do	462	1.78	2.7	
June 26	do	459	1.74	2.7	
June 30	do	518	2.02	2.9	1
July 6	do	457	1.82	2.7	
July 11	do	446	1.65	2.65	
July 16	do	403	1.50	2.55	
July 21	do	411	1.42	2.55	
July 27	do	404	1.39	2.5	
July 30	do	401	1.38	2.5	
August 7	do	406	1.40	2.5	
August 11	do	407	1.39	2.5	
August 16	do	402	1.35	2.5	
August 22	do	401	1.39	2.5	
August 25	do	402	1.43	2.5	
August 30	do	403	1.38	2.5	
September 4	do	552	1.80	3.0	1
September 18	do	405	1.67	2.5	6
September 23	do	403	1.66	2.5	6
September 26	do	403	1.63	2.5	6
September 29	do	405	1.62	2.5	6
October 4	do	403	1.54	2.5	6
October 12	do	403	1.45	2.5	5
October 17	do	402	1.41	2.5	5
October 25	do	396	1.23	2.45	4
October 30	do	401	1.27	2.5	5
November 4	do	396	1.28	2.5	5
November 11	do	396	1.27	2.5	5
November 16	do	401	1.26	2.5	5
November 24	do	396	1.23	2.5	4
November 30	do	396	1.60	2.5	6
December 5	H. F. Collins	372	1.54	2.45	5
December 10	do	372	1.59	2.45	5
December 18	do	365	1.62	2.45	5
December 26	do	365	1.62	2.45	5

Daily gage height, in feet, of Devils River at Devils River, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
.....	2.3	2.3	2.3	6.0	4.1	2.85	2.95	2.5	2.5	2.7	2.5	2.45
.....	2.3	2.3	2.3	3.65	3.5	2.8	2.8	2.5	2.5	3.1	2.5	2.45
.....	2.3	2.3	2.3	2.9	3.0	2.85	2.8	2.5	3.2	2.85	2.5	2.45
.....	2.3	2.3	2.3	2.8	2.85	2.95	2.7	2.5	3.1	2.55	2.5	2.45
.....	2.3	2.3	2.3	2.7	2.8	2.8	2.7	2.5	2.7	2.5	2.5	2.45
.....	2.3	2.3	2.3	2.7	2.8	2.8	2.7	2.5	2.6	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.6	2.7	2.7	2.7	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.6	2.7	2.65	2.7	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.55	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.55	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.55	2.7	2.6	2.65	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.5	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.45	2.7	2.65	2.6	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.5	2.85	2.7	2.55	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.35	2.5	2.75	2.7	2.5	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.7	2.5	2.7	2.7	2.55	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.6	2.45	2.65	2.7	2.55	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.6	2.4	2.5	2.7	2.55	2.5	2.55	2.5	2.5	2.45
.....	2.3	2.3	2.6	2.4	2.5	2.7	2.55	2.5	3.8	2.5	2.5	2.45
.....	2.3	2.3	2.6	2.4	2.5	2.7	2.55	2.5	2.75	2.8	2.5	2.45
.....	2.3	2.3	2.5	2.4	2.5	2.9	2.55	2.5	2.5	2.5	2.5	2.45
.....	2.3	2.3	2.5	2.4	2.5	2.7	2.55	2.5	2.5	2.45	2.5	2.45
.....	2.3	2.3	2.5	2.55	2.5	2.7	2.55	2.5	2.5	2.45	2.5	2.45
.....	2.3	2.3	2.5	3.1	2.75	2.7	2.55	2.5	2.5	2.45	2.5	2.45
25.....	2.3	2.3	2.4	4.9	2.7	2.7	2.55	2.5	2.5	2.45	2.5	2.45
26.....	2.3	2.3	2.4	4.9	2.8	2.7	2.55	2.5	2.5	2.45	2.5	2.45
27.....	2.3	2.3	2.4	2.9	2.9	2.7	2.5	2.5	2.5	2.45	2.5	2.45
28.....	2.3	2.3	2.4	2.7	2.85	2.8	2.5	2.5	2.5	2.45	2.5	2.45
29.....	2.3	.....	2.4	2.6	2.7	5.0	2.5	2.5	2.5	2.45	2.5	2.45
30.....	2.25	.....	2.4	4.2	2.7	3.25	2.5	2.5	2.5	2.5	2.5	2.4
31.....	2.25	.....	2.4	.....	3.25	.....	2.5	2.5	.....	2.5	.....	2.4

Daily discharge, in second-feet, of Devils River at Devils River, Tex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	445	440	435	6,470	2,260	990	1,090	555	570	770	510	[illegible]
2	445	440	440	1,750	1,590	930	940	560	580	1,100	510	[illegible]
3	445	435	440	840	1,020	990	930	560	1,200	870	510	[illegible]
4	450	435	440	770	a 850	1,110	830	560	a 1,100	a 650	a 510	[illegible]
5	450	435	445	a 710	795	a 930	a 830	565	750	615	510	a [illegible]
6	450	430	445	710	795	930	825	565	680	610	510	[illegible]
7	450	430	470	655	690	820	820	a 565	620	605	505	[illegible]
8	450	a 430	470	655	690	770	810	565	620	600	505	[illegible]
9	a 450	430	470	630	690	720	705	565	630	595	505	[illegible]
10	450	430	470	630	690	720	700	565	630	590	500	a [illegible]
11	450	430	475	630	690	720	a 735	a 565	640	585	a 500	[illegible]
12	450	430	475	600	a 690	720	680	565	640	a 585	500	[illegible]
13	450	430	a 475	a 565	690	770	675	560	650	580	500	[illegible]
14	450	430	475	600	850	a 820	620	555	650	575	505	[illegible]
15	450	430	475	600	750	820	570	550	660	570	505	[illegible]
16	450	a 430	840	600	700	820	a 605	a 540	660	565	a 505	[illegible]
17	a 450	430	a 760	565	a 655	820	600	545	670	a 565	505	[illegible]
18	450	430	760	a 535	510	820	595	550	a 720	555	505	a [illegible]
19	450	430	760	535	525	820	590	555	1,920	550	505	[illegible]
20	445	435	760	535	540	820	585	555	890	820	500	[illegible]
21	445	435	a 680	535	555	1,040	a 580	560	670	530	500	[illegible]
22	445	435	665	535	570	a 820	580	a 560	670	505	495	[illegible]
23	445	435	650	630	585	820	580	565	a 670	500	495	[illegible]
24	445	435	635	1,010	850	810	580	570	660	490	a 490	[illegible]
25	a 445	435	a 545	a 3,170	a 815	810	580	a 575	660	a 485	500	[illegible]
26	445	435	545	3,170	940	a 800	580	575	a 655	485	520	a [illegible]
27	445	a 435	545	840	1,060	800	a 560	570	655	485	540	[illegible]
28	445	435	540	710	1,030	920	560	565	655	485	570	[illegible]
29	445	.....	540	650	910	3,280	555	560	a 660	485	600	[illegible]
30	a 425	.....	a 540	a 2,370	a 930	a 1,400	a 555	a 560	660	a 510	a 630	[illegible]
31	425	.....	540	.....	1,480	.....	555	560	.....	510	.....	[illegible]

a Meter measurement.

Estimated monthly discharge of Devils River at Devils River, Tex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	450	425	446	[illegible]
February	440	430	433	[illegible]
March	840	435	555	[illegible]
April	6,470	535	1,107	[illegible]
May	2,260	510	851	[illegible]
June	3,280	720	945	[illegible]
July	1,090	555	677	[illegible]
August	575	540	561	[illegible]
September	1,920	570	736	[illegible]
October	1,100	485	594	[illegible]
November	630	490	515	[illegible]
December	595	510	582	[illegible]
The year	6,470	425	667	[illegible]

SAN FELIPE CREEK AT DEL RIO, TEX.

San Felipe Creek rises in four large springs northeast of Del Rio, and flows southward into the Rio Grande. The waters of these springs are used in two large irrigation systems, the one on the west side of the creek having been in use for many years, while the one on the east has only recently been constructed by G. Bedell Moore. The following table shows the discharge measurements that have been taken on the combined flow of the Madre ditch and the creek just south of the bridge of the Southern Pacific Railroad.

Discharge measurements of San Felipe Creek at Del Rio, Tex., 1895–1905.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
December, 1895	C. C. Babb	99	
March, 1899	T. U. Taylor	113	
September, 1900	do	149	Rainy season.
December, 1901	C. N. Campbell	150	After Brackett flood.
September, 1902	T. U. Taylor	115	
March, 1904	do	118	Includes 38 second-feet in ditch.
August, 1905	do	103	

LAS MORAS CREEK NEAR BRACKETTVILLE, TEX.

Las Moras Creek, like its sister springs of the Edwards Plateau, rises very suddenly. It is located near the twin towns of Brackettville and Fort Clark, and threads its way between the two. It flows south, supporting many irrigation systems, and finally empties into the Rio Grande 25 miles above Eagle Pass. Its flow is extremely variable, being a reflex barometer of the season preceding, and like the Leona at Uvalde, it gives a safe index of the rainfall of the Edwards Plateau for months before. The following table shows the discharge measurements that have been taken:

Discharge measurements of Las Moras Creek near Brackettville, Tex., 1895–1905.

Date.	Hydrographer.	Discharge.	Remarks.
		Second-feet.	
December, 1895	C. C. Babb	21	At footbridge, Brackettville.
June, 1899	T. U. Taylor	60	At Mulligans Bend.
September, 1900	do	51	Do.
September, 1902	do	11	Do.
September, 1902	do	11	Do.
March, 1904	do	28	Do.
August, 1905	do	14	Do.

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1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
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1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
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West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
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DEPARTMENT OF THE INTERIOR
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CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART XI.—Colorado River Drainage above Yuma

BY

M. C. HINDERLIDER and G. L. SWENDSEN

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART XI.

By M. C. HINDERLIDER and G. L. SWENDSEN.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collecton of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys, fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power special effort is made to obtain information concerning the

minimum flow; if water is to be stored the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations and their records in connection with short series of measurements serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware River drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage above Yuma.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California and Colorado River drainage below Gila River.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

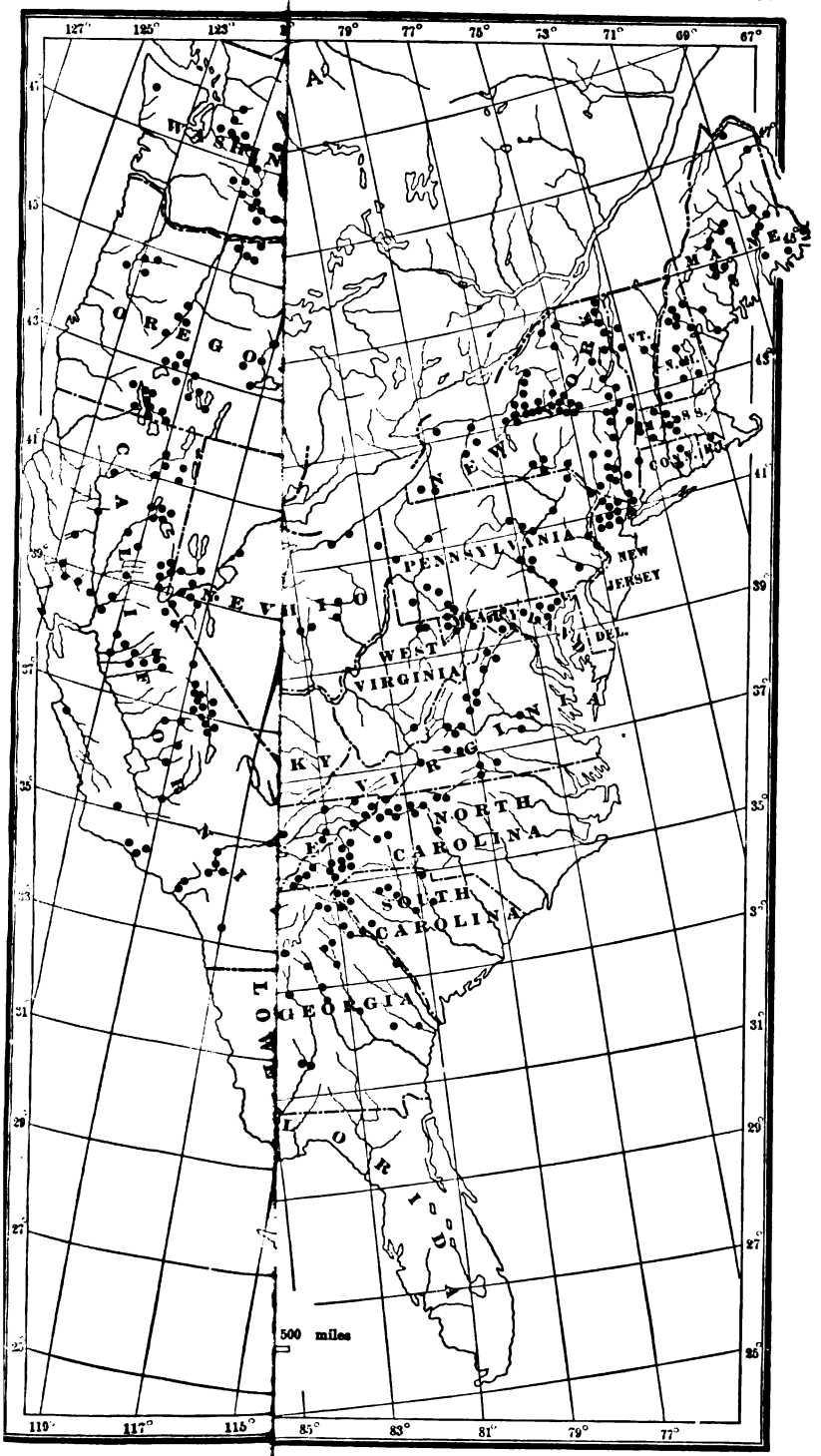
List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor southern Atlantic.


127°
125°
123°
79°
77°
75°
73°
71°
69°
67°
OREGON
NEVADA
UTAH
COLORADO
ARIZONA
NEW MEXICO
MONTANA
WYOMING
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
VT.
N.H.
MAINE
MASS.
CONN.
R.I.
NEW JERSEY
DEL.
500 miles
119°
117°
115°
85°
83°
81°
79°
77°

URING 1905.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Applachicola.	Minor eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississipppi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadalupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS

DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharge," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rain fall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the area of cross section, the mean velocity, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise, in the column of "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; 0.125; 0.012; 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second, nearly.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.
To calculate water power quickly: $\frac{\text{Sec. ft.} \times \text{fall in feet}}{11}$=net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:

Scale 1 : 125000, 1 mile=0.50688 inch.
Scale 1 : 90000, 1 mile=0.70400 inch.
Scale 1 : 62500, 1 mile=1.01376 inches.
Scale 1 : 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be devided with respect to their physical conditions into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of the water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates, the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve for a critical stage of considerable duration the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

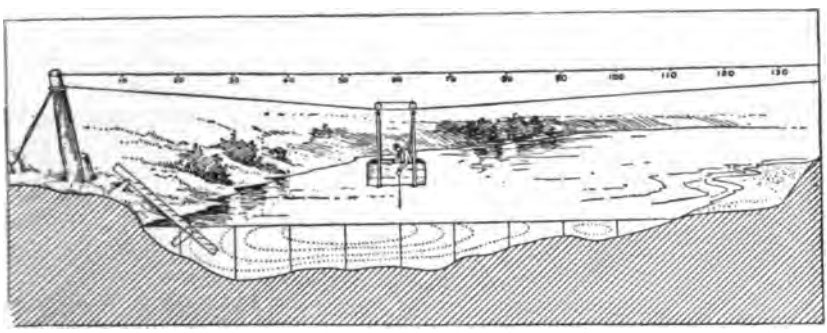


FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures usually referred to as "equipment" are generally appurtenant to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements, coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and conditions of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity curve, 0.2 and 0.8 depth, and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements taken on many streams under and varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95 depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point in the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as

shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage

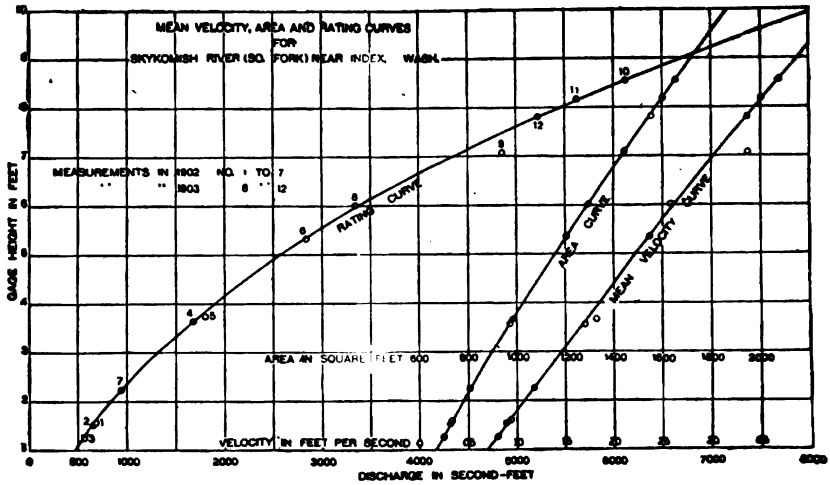


FIG. 2.—Rating, area, and mean-velocity curves for South Fork of Skykomish River near Index, Wash.

of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remains constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The platting of results of the various discharge measurements, using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage heights or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method or a graphical application of it is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Arizona.—District hydrographer, W. A. Farish,[a] assisted by H. S. Reed, W. Richins, O. Richins, R. H Ross, H. R. Fry, F. Asplind, Prof. G. E. P. Smith, R. L. Newman, and E. O. Blades.

California.—The hydrographic work of the United States Geological Survey in the Colorado River drainage in California has been carried on in cooperation with the State under the direction of Supervising Engineer J. B. Lippincott,[b] assisted by Engineer W. B. Clapp.

Colorado.—District and resident engineer, M. C. Hinderlider,[c] assisted by R. I. Meeker, William A. Lamb, H. G. Graham, A A. Weiland, O H. Timmerman, Melvin Beeson, Thomas E. Brick, and F. L. Meeker. Acknowledgments are due the Denver and Rio Grande, Colorado and Southern, Burlington and Missouri River, and Union Pacific railroads for transportation furnished to the district hydrographer and assistants. Acknowledgments are also due the Denver Union Water Company for the use of their reservoir as a rating station for current meters.

Nevada.—The hydrographic work in this section has been carried on in cooperation with the State by Henry Thurtell,[d] State engineer, assisted by W. A. Wolf, J. T. Shaw, R. A. Craig, O. F. Heizer, H. H. Church, and L. A. Woolley. Acknowledgment is due to the Southern Pacific Company for transportation furnished to the district hydrographer and assistants, and also to the San Pedro Los Angeles, and Salt Lake Railroad for transportation furnished to the State engineer.

New Mexico.—The hydrographic work in the northern portion of this Territory was carried on under the direction of the district hydrographer, M. C. Hinderlider, assisted by R. I. Meeker and O. H. Timmerman. Acknowledgments are due the Denver and Rio Grande Railroad for transportation for R. I. Meeker.

Utah.—Engineer George L. Swendsen,[e] assisted by W. G. Swendsen, acting hydrographer, and A. B. Larson. Acknowledgments are due to the Oregon Short Line, Denver and Rio Grande, and San Pedro, Los Angeles and Salt Lake railroads for transportation; to the Telluride Power Company, the Spanish Fork and Payson canal companies, the Sevier River water users, and State Engineer C. Tanner; also to Doctor Hyatt, of the United States Weather Bureau, for material assistance in field observations. The Salt Lake daily papers have continued their interest by following conditions very closely. The hydrographic work in the Uinta Indian Reserve and on upper Green River in Utah has been carried on under the direction of the district hydrographer, M. C. Hinderlider, by the resident hydrographer, Howard S. Reed, with headquarters at Fort Duchesne.

Wyoming.—The hydrographic work in this State has been carried on under the direction of the district hydroprapher, M. C. Hinderlider, and by the resident hydrographer, A. J. Parshall. Acknowledgments are due the Union Pacific Railroad for annual passes over its lines in Wyoming for the resident hydrographer.

GENERAL DESCRIPTION OF COLORADO RIVER DRAINAGE BASIN.

Colorado River is formed in the southeastern part of Utah by the junction of Grand and Green rivers. Green River is larger than the Grand and is the upward continuation of the Colorado. Including the Green the entire length of the Colorado is about 2,000 miles. The region drained is about 800 miles long, varies in width from 300 to 500 miles, and contains about 300,000 square miles. It comprises the southwestern part of Wyoming, the western part of Colorado, the eastern half of Utah, practically all of Arizona, and small portions of California, Nevada, New Mexico, and old Mexico. Most of this area is arid, the mean annual rainfall being about 8½ inches. The streams receive their supply from the melting snows on the high mountains of Wyoming, Utah, and Colorado.

There are two distinct portions of the basin of the Colorado. The lower third is but little above the level of the sea, though here and there ranges of mountains rise to elevations of 2,000 to 6,000 feet. This part of the valley is bounded on the north by a line of cliffs which present a bold, often vertical, step hundreds or thousands of feet, to the table-land above. The upper two-thirds of the basin stands from 4,000 to 8,000 feet above sea level, and is bordered on the east, west, and north by ranges of snow-clad mountains which attain altitudes varying from 8,000 to 14,000 feet above sea level. Through this plateau the Colorado and its tributaries have cut narrow gorges or canyons in which they

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[d] Office, Carson, Nev.
[e] Office, Salt Lake City, Utah.

flow at almost inaccessible depths. At points where lateral streams enter, the canyons are broken by narrow, transverse valleys, diversified by bordering willows, clumps of box elder, and small groves of cottonwood. The whole upper basin of the Colorado is traversed by a labyrinth of these canyons, most of which are dry during the greater portion of the year, and carry water only during the melting of the snow and the brief period of the autumnal and spring rains.

Low mesas, dry and treeless, stretch back from the brink of the canyons, and beyond are long lines of brilliantly colored cliffs, scores or hundreds of miles in length and hundreds or thousands of feet in altitude, presenting steep or even vertical faces of rock. These cliffs form a series of terraces, and each marks the boundary "of some geological series of strata the edges of which are exposed, like courses of masonry, in the scarp walls of the palisades." [a] The lateral extension of such a line of cliffs is very irregular, sharp salients being projected on the plains below and deep recesses cut into the terraces above.

The region is further diversified by short ranges of eruptive mountains. A vast system of fissures extends across the country, and huge cinder cones, red, brown, and black, stand along the fissures and form conspicuous landmarks, set, as they are, in contrast to the bright varigated rocks of sedimentary origin.[b]

As a matter of convenience the drainage area has been divided into three basins: (1) Green River basin, (2) Grand River basin, and (3) Colorado River below the junction of Grand and Green rivers, and each of these basins is subdivided to allow the separate description of branches of the main river.

GREEN RIVER DRAINAGE BASIN.

AREA AND EXTENT.

Green River and its tributaries drain an area rudely triangular in outline, bounded on the north and east by the Wind River Mountains and the ranges forming the Continental Divide, on the south and east by the White River Plateau and the Roan or Book Cliffs, and on the north and west by the Gros Ventre and Wyoming mountains and the great Wasatch Range. The greatest length of the basin, north and south, is about 370 miles. In an east-west direction it measures at its widest point about 240 miles. The total drainage area is approximately 41,000 square miles.

The area includes a large part of western Wyoming, northwestern Colorado, and eastern Utah. The Uinta and Uncompahgre Indian reservations are located in this basin in northeastern Utah.

In the following account of the work of the United States Geological Survey in this region during 1905 the basin has been subdivided, as a matter of convenience, the main river being described first and the tributary streams, beginning at the headwaters, afterwards.

GREEN RIVER.

DESCRIPTION OF BASIN.

Green River heads on the west slope of the Wind River Mountains in western Wyoming, its ultimate source being a number of small lakes fed by the glaciers and immense snow deposits always to be found on Fremont and neighboring peaks. For perhaps 25 miles the river flows northwestward through the mountains. It then turns abruptly and runs in a general southerly direction across western Wyoming into Utah. A few miles below the Wyoming-Utah boundary another sharp turn carries the river eastward along the Uinta Mountains, through which it breaks near the east end of the range. It then flows southward in Colorado for about 25 miles, turns back into Utah, and continues to flow in a southwesterly and southerly direction until it unites with the Grand to form the Colorado. Its length, measured roughly along the course, is approximately 425 miles.

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[a] Dutton, C. E., Physical geology of the Grand Canyon district: Second Ann. Rept. U. S. Geol. Survey, 1882, p. 51.

[b] Powell, J. W., Exploration of the Colorado River of the West, Washington, 1875, p. 6.

The topography of the headwater region is rugged in the extreme. The Wind River Range on the east and the Gros Ventre and Wyoming ranges on the northwest and west gradually close in as they extend southward, forming a basin comprising approximately 7,450 square miles in extent above the gaging station at Green River, Wyo. The upper part of this basin is very narrow, but southward the valley opens out and near Fontanelle, Wyo., is several miles wide, with benches and rolling table-lands extending westward to the foothills of the Wyoming Range and eastward to the bluffs which hug the east bank of the river. At Green River the valley is again narrow—only a few hundred yards in width—and for some distance southward the river runs between bluffs standing so close together that no flood plain is seen. Throughout much of its course in Utah the Green flows through a succession of long, deep, narrow canyons, with walls ranging in height from a few hundred to as many thousand feet, separated by short valleys containing small tracts of arable lands.

In its upper course the Green receives as tributaries numerous streams heading in the Wind River, Gros Ventre, and Wyoming ranges of mountains, some of them extending so far back into the abrupt, ragged canyons that they dovetail with streams flowing in opposite directions. The most important of these tributaries are Newfork River, Big Sandy Creek, La Barge Creek, Fontanelle Creek, Black Fork, and Henry Fork. South of the Uinta Mountains the first large stream flowing into the Green is the Yampa, which comes in from the east at the point where the Green turns westward to reenter Utah after its southward journey in Colorado. Farther south Ashley Creek and Uinta and White rivers discharge their waters to the Green, Ashley Creek and the Uinta from the west and the White from the east. Below this point the only tributaries of importance are Minnie Maud Creek and San Rafael River, which enter from the west, the latter at a point about 32 miles above the junction of the Green and the Grand.

In the foothills and in close proximity to the main ranges of the upper portion of the basin the soil is sand mixed with disintegrated granite, changing into a light, sandy loam on the rolling uplands, and a rich alluvial deposit in the valleys adjacent to the waterways. Very little land is under cultivation, and except in a few favored localities the only product is hay, which is consumed by the stock grazed on the surrounding hills. Directly south of the Uinta Mountains, in the region drained by Ashley Creek and Uinta, Whiterocks, and Duchesne rivers, large tracts of excellent agricultural land are found, much of it being comprised in the Uinta Indian Reservation.

The geology of this basin is described in the Eleventh Annual Report of the United States Geological and Geographical Survey of the Territories for 1877, F. V. Hayden in charge, pages 509-646. Information in regard to the hydrography is contained in the first to fourth annual reports of the Reclamation Service and in other United States Geological Survey reports.

GREEN RIVER AT GREENRIVER, WYO.

This station was established May 2, 1895, near the pump house at a point about 40 feet below the bridge of the Union Pacific Railroad, at Greenriver, Wyo. Since that date it has been maintained continuously, except for a few months during the winter and during the year 1900.

The channel is straight for about 500 feet above and 300 feet below the measuring section, and the banks are sufficiently high to prevent overflow. The bed of the stream is composed of sand. During low-water periods the entire right half of the channel is a bed of clean sand shifting more or less each year, and the stream runs in a single channel on the left; but as the water rises it extends across the two channels and under the approaches of the bridge. At the gage there are at ordinary stages two channels and at times of flood four channels, interrupted, to some extent, by open cribs four feet wide, made by spiking heavy planks to piles driven into the bed of the stream, which here is sandy but stable.

Discharge measurements are made from the iron highway bridge about one-half mile below the railway bridge, as the section under the latter is unsatisfactory for the purpose. The initial point for soundings is a deep notch cut in the railing near the end of the bridge on the left bank.

The gage, which was observed during 1905 by William Slater, is a staff securely fastened to heavy submerged cribbing on the east bank of the river. The bench mark is a cross on the third step from the bottom of the south end of the east abutment of the railroad bridge; elevation 12.48 feet above the zero of the gage. It has not changed perceptibly since so placed.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 272-273; Bull 140, p 200; WS 16, p 135; 28, p 131; 37, pp 286-287; 50, pp 366-367; 66, p 82; 85, p 75; 100, p 124; 133, p 53.

Discharge: Ann 18, iv, p 274; Bull 140, p 200; WS 16, p 135; 28, p 142; 37, p 287; 66, p 82; 85, p. 75; 133, p 54.

Discharge, monthly: Ann 18, iv, p 275; 19, iv, p 395; 20, iv, pp 378-380; 21, iv, p 302; Bull 140, p 201; WS 75, p 164; 85, p 77; 133, p 56.

Discharge, yearly: Ann 20, iv, p 58.

Gage heights: Bull 140, p 201; WS 11, p 70; 16, p 135; 28, p 134; 37, p 287; 50, p 367; 66, p 83; 85, p 76; 100, p 125; 133, p 54.

Hydrographs: Ann 18, iv, p 275; 19, iv, p 396; 20, iv, p 381; 21, iv, p 303.

Rainfall and run-off relation: Ann 20, iv, p 379.

Rating tables: Ann 18, iv, p 274; 19, iv, p 395; Bull 140, p 201; 28, p 144; 39, p 451; 66, p 173; 85, p 76; 133, p 55.

Discharge measurements of Green River at Greenriver, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 26	A. J. Parshall	164	470	1.53	0.88	718
April 6	do	163	470	1.22	.85	573
April 16	do	164	535	1.67	1.15	894
April 28	do	170	644	2.13	1.70	1,374
May 18	do	166	540	1.58	1.15	854
May 28	do	234	907	2.81	2.35	2,546
June 12	do	289	1,702	4.46	4.00	7,590
June 25	do	284	1,258	3.71	3.05	4,666
June 29	do	284	1,353	3.78	3.25	5,116
July 25	do	240	919	2.60	2.30	2,392
August 6	do	170	683	2.03	1.70	1,389
August 16	do	166	621	1.77	1.40	1,103
September 8	do	164	562	1.35	1.00	759
September 23	do	159	495	.90	.55	445
October 20	do	160	509	.93	.65	476

Daily gage height, in feet, of Green River at Greenriver, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.8	1.42	2.65	3.4	1.95	1.2	0.7
2	.85	1.45	2.68	3.3	1.9	1.2	.75
3	.8	1.55	2.85	3.32	1.82	1.2	.8
4	.82	1.72	3.12	3.22	1.8	1.2	.78
5	.85	1.8	3.48	3.08	1.75	1.25	.75
6	.88	1.78	3.7	3.02	1.7	1.28	.72
7	.95	1.7	3.95	2.95	1.65	1.22	.7
8	.92	1.68	3.78	2.88	1.65	1.2	.7
9	.95	1.58	3.7	2.82	1.6	1.15	.65
10	1.05	1.55	3.95	2.8	1.58	1.1	.65
11	1.22	1.5	4.08	2.72	1.55	1.02	.65
12	1.25	1.45	3.95	2.65	1.5	.92	.6
13	1.2	1.35	3.72	2.62	1.45	.82	.6
14	1.15	1.3	3.48	2.7	1.45	.75	.6
15	1.15	1.22	3.65	2.72	1.45	.72	.6
16	1.15	1.18	3.9	2.75	1.38	.7	.6
17	1.2	1.1	4.0	2.75	1.32	.65	.6
18	1.2	1.15	4.0	2.78	1.28	.65	.6
19	1.2	1.3	4.28	2.72	1.2	.65	.55
20	1.25	1.5	3.95	2.68	1.15	.6	.55
21	1.28	1.68	3.6	2.6	1.2	.6	.55
22	1.3	1.72	3.25	2.55	1.2	.55	.55
23	1.28	1.88	3.05	2.45	1.2	.55	.55
24	1.28	1.98	3.0	2.42	1.2	.55	.55
25	1.35	2.2	3.02	2.32	1.25	.5	.55
26	1.42	2.3	3.1	2.22	1.2	.5	.52
27	1.52	2.3	3.15	2.2	1.2	.5	.5
28	1.58	2.42	3.22	2.15	1.15	.55	.5
29	1.6	2.58	3.32	2.12	1.2	.58	.5
30	1.55	2.72	3.4	2.08	1.2	.62	.55
31	.....	2.75	.....	2.0	1.2	.....	.55

Station rating table for Green River at Greenriver, Wyo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	420	1.50	1,160	2.50	2,910	3.50	5,920
.60	475	1.60	1,265	2.60	3,180	3.60	6,250
.70	535	1.70	1,380	2.70	3,460	3.70	6,585
.80	600	1.80	1,510	2.80	3,745	3.80	6,920
.90	670	1.90	1,655	2.90	4,035	3.90	7,255
1.00	745	2.00	1,815	3.00	4,330	4.00	7,590
1.10	820	2.10	1,995	3.10	4,635	4.10	7,930
1.20	900	2.20	2,195	3.20	4,945	4.20	8,270
1.30	980	2.30	2,415	3.30	5,265	4.30	8,610
1.40	1,065	2.40	2,655	3.40	5,590		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1905 and is well defined.

Estimated monthly discharge of Green River at Greenriver, Wyo., for 1905.

[Drainage area, 7,450 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	1,265	600	883	52,540	0.119	0.133
May	3,602	820	1,582	97,270	.212	.244
June	8,542	3,320	5,947	353,900	.798	.890
July	5,590	1,815	3,459	212,700	.464	.535
August	1,735	860	1,122	68,990	.151	.174
September	964	420	639	38,020	.086	.096
October	600	420	486	29,880	.065	.075
The period				853,300		

GREEN RIVER AT JENSEN, UTAH.

This station was established November 7, 1903. It is located at Jensen post-office, about 300 feet below what is known as Billings Ferry, 15 miles from Vernal. The nearest railroad station, Dragon, Utah, is about 40 miles distant. Brush Creek enters the river 1½ miles above the station and Ashley Creek 3 miles below.

The channel is straight for about 1,000 feet above and below the station. The right bank is high, is composed of gravel, and will not overflow; the left bank is low and sandy and covered with underbrush. The bed of the stream is sandy and shifting. There is but one channel at all stages.

The first discharge measurements were made from the ferryboat, but the station was equipped with a cable and car during 1904. The initial point for soundings is the first white mark on the cable on the right bank.

The gage is a vertical timber 10 feet long, braced to a cottonwood tree about 10 feet from the edge of the river. The gage is referred to bench marks as follows: (1) A 40-penny spike driven into the cottonwood tree to which the gage is attached; elevation, 10.66 feet above the zero of the gage. (2) A 40-penny spike driven into the southwest corner of Mr. Billings's grain house about 3 feet above the ground; elevation, 25.64 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 123-124; 133, p 56.
Discharge: 100, p 124; 133, p 57.
Discharge, monthly: 133, p 58.
Gage heights: 100, p 124; 133, p 57.
Rating table: 133, p 58.

Daily gage height, in feet, of Green River at Jensen, Utah, for 1905.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1	8.9	6.96	3.86	12	11.1	5.28	.....	22	8.28	4.7	.....
2	9.18	6.79	3.82	13	10.88	5.2	.....	23	7.52	4.52	.....
3	9.59	6.73	3.68	14	10.36	5.09	.....	24	7.71	4.48	.....
4	9.81	6.64	3.6	15	9.98	4.97	.....	25	7.66	4.4	.....
5	10.15	6.68	3.48	16	9.75	4.92	.....	26	7.59	4.25	.....
6	10.4	6.49	.....	17	9.52	4.87	.....	27	7.4	4.1	.....
7	11.09	6.11	.....	18	9.49	4.82	.....	28	7.23	3.99	.....
8	11.16	5.88	.....	19	9.46	4.86	.....	29	7.09	3.93	.....
9	10.92	5.69	.....	20	9.34	4.86	.....	30	6.96	4.0	.....
10	10.82	5.47	.....	21	8.86	4.82	.....	31	.....	3.76	.....
11	10.05	5.39	.....								

GREEN RIVER AT OURAY, UTAH.

This station was established March 23, 1904. It is located about 500 feet below the ferry maintained by the Government at Ouray, Utah. The nearest town is Vernal, Utah, 35 miles distant, and the nearest railroad station is Dragon, about 35 miles distant.

The channel is slightly curved for about 2,000 feet above and is straight for 1,200 feet below the station. Both banks are fairly high and timbered. The right bank overflows for a short distance at high stages. The bed is composed of clean sand and is shifting. The stream is usually confined to one channel, which changes as sand bars are formed during high water. The velocity is fairly good.

Discharge measurements are made from the Government ferry cable, which is suspended across the river about 500 feet above the gage. The initial point for soundings is the first white mark on the cable on the right bank of the river.

The gage is a staff securely driven into the river bottom and spiked to a large cottonwood tree that overhangs the right bank. The gage is referred tc bench marks as follows: (1) A large nail driven into the inside face of the tree that supports the gage rod; elevation, 13.80 feet above the zero of the gage. (2) A large nail driven into a blaze on a root of one of a group of large cottonwood trees 150 feet northeast of the gage; elevation, 13.51 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 59–60.

Daily gage height, in feet, of Green River at Ouray, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	0.5	0.8	1.45	1.15	4.32	8.45	5.75
2	.5	.8	1.55	1.1	4.75	8.75	5.55
3	.5	.82	1.72	1.1	5.0	9.25	5.48
4	.5	.88	1.92	1.0	5.6	9.72	5.32
5	.5	.95	2.0	1.0	5.95	10.1	5.22
6	.5	1.0	1.9	1.02	5.4	10.28	5.05
7	.5	1.0	1.75	1.1	4.82	10.72	4.85
8	.5	1.0	1.5	1.02	4.45	11.12	4.42
9	.5	1.0	1.25	.92	4.25	11.28	.....
10	.5	1.0	1.1	1.0	4.1	10.95	.....
11	.55	1.0	1.0	1.5	4.22	10.4	.....
12	.65	1.0	1.0	1.82	4.4	10.55	.....
13	.7	1.0	1.0	2.1	4.7	10.75	.....
14	.7	1.02	.95	2.3	4.6	10.22	.....
15	.7	1.08	.9	2.3	4.28	9.72	.....
16	.7	1.1	1.0	2.3	4.0	9.35	.....
17	.7	1.12	1.05	2.3	3.95	8.92	.....
18	.7	1.18	1.2	3.05	4.05	8.88	.....
19	.7	1.2	1.32	3.05	4.45	8.7	.....
20	.7	1.22	1.38	3.3	5.65	8.38	.....
21	.7	1.25	1.4	2.65	6.55	8.25	.....
22	.7	1.25	1.42	2.7	7.22	8.0	.....
23	.7	1.25	1.48	2.9	7.72	7.7	.....
24	.7	1.28	1.5	2.75	8.3	7.32	.....
25	.7	1.3	1.5	2.65	8.78	6.9	.....
26	.7	1.3	1.48	2.75	8.95	6.58	.....
27	.7	1.3	1.38	3.05	9.1	6.5	.....
28	.7	1.3	1.28	3.2	8.9	6.28	.....
29	.7	.....	1.18	3.3	8.9	6.1	.....
30	.72	.....	1.1	3.5	8.72	5.9	.....
31	.78	.....	1.2	.....	8.52	.....	.....

GREEN RIVER AT GREENRIVER, UTAH.

This station was established October 21, 1894, discontinued in November, 1896, and reestablished February 16, 1905. It is located at the Rio Grande Western Railway bridge at Greenriver (formerly Blake), Utah, in latitude 39° north, longitude 110° 9′ west, in the San Rafael quadrangle.

The channel is straight for about 2,000 feet above and 1,000 feet below the station. Both banks are barren and are sufficiently high to prevent overflow. At the ferry cable the bed is of clay and shale and is apparently permanent except for a thin layer of silt or sand, which is deposited near the center at low stages and sluices out at high stages. The bed at the railroad bridge is in the main solid rock and is probably permanent, but is rather rough in profile. Conditions for high-water measurements are unfavorable owing to the large masonry piers of the bridge and the high velocity of the current. The velocity at the low-water section is low. Information in regard to winter conditions is incomplete.

At low and ordinary stages discharge measurements are made from a ferryboat at a point 400 to 500 feet above the bridge. The cable to which the ferryboat is attached is graduated at 20-foot intervals with white paint. The initial point for soundings is the south face of a blazed tree, to which the cable is attached, on the west side of the stream. High-water measurements are made from the lower chord on the upstream side of the steel-truss railroad bridge. The initial point for soundings is a white zero mark across the rail on the east end of the bridge.

The gage, which was read during 1905 by Frank Jacobs, is of the chain type, and is attached to the upper guard rail of the bridge at a point near the second pier from the west end. The length of the chain is 28.45 feet. The distance from the outside edge of the pulley to the 3-foot mark on the gage rod is 1.85 feet. The old bench mark established in 1894 was on a pier, but a new bridge has since been constructed and the pier changed. It was therefore impossible to get a definite tie to the original datum. A rough tie was, however, obtained from the old inclined gage on the shore near the pump house, and this showed the present datum to be 1.68 feet below the original. In view of the fact that the cross section at the gage has been changed to some extent by the relocation of the bridge piers, it is probably impossible to establish a satisfactory relation between the original records and those now being taken. The present bench mark is the top of a 1¼-inch iron drift bolt set in the west abutment of the railroad bridge on the north side. The bolt projects about 8 inches above the surface of the stone and is on one of the footing courses of the abutment about 3 feet from the top; elevation of bench mark above the zero of the gage, 25.64 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 275-276; Bull 131, p 48; 140, pp 202-203; WS 16, p 136; 28, p 131; 37, pp 292-293.
Discharge: Ann 18, iv, p 276; 19, iv, p 396; Bull 131, pp 48, 92; 140, p 202; WS 16, p 136; 37, p 293.
Discharge, monthly: Ann 18, iv, p 278; 19, iv, p 398; 20, iv, p 378, 387; 21, iv, p 304.
Discharge, yearly: Ann 20, iv, p 58.
Gage heights: Bull 140, p 203; WS 11, p 70; 16, p 136; 28, p 134; 37, p 293.
Hydrographs: Ann 18, iv, p 279; 19, iv, p 398; 20, iv, p 388; 21, iv, p 305.
Rainfall and run-off relation: Ann 20, iv, p 379.
Rating tables: Ann 18, iv, p 277; 19, iv, p 397; WS 28, p 144; 30, p 451.

Discharge measurements of Green River at Greenriver, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 16 [a]	W. G Swendsen	450	1,605	1.95	4.70	3,129
April 25 [a]	do	452	2,292	2.33	5.65	5,338
April 25 [a]	do	452	2,292	2.34	5.65	5,380
May 12 [b]	do	448	2,800	3.46	6.40	9,686
June 2 [b]	do	474	3,864	5.76	8.80	22,270
June 20 [b]	do	482	3,983	6.35	9.05	25,310
August 23 [a]	A. B. Larson	438	1,659	1.31	4.14	2,175
August 23 [a]	do	438	1,659	1.30	4.14	2,160

[a] Measurement made from ferryboat. [b] Measurement made from railroad bridge.

Daily gage height, in feet, of Green River at Greenriver, Utah, for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.8	4.6	5.95	8.95	7.5	5.05	3.9	5.9	4.0	3.9
2		3.9	4.75	6.1	8.8	7.4	5.0	3.9	5.2	4.05	3.8
3		3.9	4.8	6.6	9.0	7.3	5.0	3.9	4.9	3.95	3.6
4		4.05	4.6	6.85	9.25	7.25	5.0	3.9	4.85	3.85	3.4
5		4.1	4.5	7.15	9.6	7.2	5.0	4.05	4.65	4.05	3.4
6		4.1	4.5	7.3	9.8	7.1	5.0	4.05	4.6	4.15	3.3
7		4.25	4.5	7.25	9.85	7.0	4.9	4.7	4.45	4.1	3.3
8		4.5	4.5	7.0	10.05	6.9	4.8	4.45	4.4	4.1	3.2
9		4.6	4.6	6.7	10.3	6.8	4.7	4.35	4.25	4.2	3.2
10		4.9	4.5	6.6	10.55	6.7	4.7	4.45	4.3	4.1	3.2
11		5.05	4.5	6.4	10.5	6.6	4.6	4.55	4.4	4.0	3.3
12		5.0	4.55	6.4	10.05	6.45	4.55	4.55	4.3	3.95	3.35
13		4.85	4.75	6.6	10.2	6.3	4.5	4.35	4.2	3.9	3.4
14		4.75	5.0	6.95	10.2	6.25	4.5	4.25	4.25	3.85	3.4
15		4.7	5.15	6.75	9.95	6.05	4.5	4.05	4.1	4.0	3.4
16	3.8	4.7	5.4	6.55	9.85	6.0	4.5	4.0	4.1	4.0	3.3
17	3.6	4.7	5.3	6.4	9.35	5.95	4.45	3.9	4.1	4.0	3.4
18	3.45	4.7	5.3	6.4	9.25	5.85	4.35	4.0	4.1	4.0	3.4
19	3.45	4.7	5.65	6.4	9.15	5.8	4.2	4.1	4.0	3.9	3.4
20	3.5	4.8	5.65	6.6	9.05	5.75	4.2	4.0	3.9	3.9	3.4
21	3.5	4.75	5.45	7.0	8.85	5.7	4.2	4.15	3.9	4.0	3.4
22	3.5	4.95	5.4	7.55	8.65	5.7	4.2	4.2	4.0	4.4	3.4
23	3.6	5.0	5.5	7.95	8.55	5.6	4.2	4.3	4.05	4.25	3.5
24	3.6	4.9	5.55	8.3	8.4	5.6	4.0	4.2	4.0	4.2	3.6
25	3.6	4.8	5.65	8.6	8.35	5.5	4.0	4.4	4.0	4.1	3.6
26	3.7	4.8	5.65	8.85	8.15	5.45	4.15	4.45	4.0	4.0	3.6
27	3.7	4.8	5.5	9.05	8.05	5.4	4.15	4.6	4.0	4.05	3.6
28	3.8	4.8	5.55	9.2	7.85	5.3	4.0	4.65	4.0	4.15	3.6
29		4.8	5.75	9.05	7.75	5.25	4.0	5.15	4.0	4.1	3.6
30		4.7	5.95	9.05	7.6	5.2	3.95	5.85	4.0	4.0	3.6
31		4.7		9.0		5.2	3.9		4.0		3.6

NOTE.—Ice conditions December 23-31.

Station rating table for Green River at Greenriver, Utah, from February 16, 1905, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	1,220	4.60	2,900	6.00	7,110	7.80	16,110
3.30	1,290	4.70	3,100	6.10	7,510	8.00	17,360
3.40	1,370	4.80	3,320	6.20	7,920	8.20	18,670
3.50	1,460	4.90	3,560	6.30	8,340	8.40	20,020
3.60	1,550	5.00	3,820	6.40	8,770	8.60	21,410
3.70	1,650	5.10	4,090	6.50	9,210	8.80	22,870
3.80	1,760	5.20	4,370	6.60	9,660	9.00	24,400
3.90	1,870	5.30	4,660	6.70	10,120	9.20	25,970
4.00	1,990	5.40	4,960	6.80	10,600	9.40	27,590
4.10	2,120	5.50	5,280	6.90	11,090	9.60	29,260
4.20	2,260	5.60	5,620	7.00	11,590	9.80	30,970
4.30	2,410	5.70	5,970	7.20	12,640	10.00	32,720
4.40	2,560	5.80	6,340	7.40	13,750	10.50	37,230
4.50	2,720	5.90	6,720	7.60	14,900		

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is fairly well defined between gage heights 4.1 feet and 9.1 feet.

Estimated monthly discharge of Green River at Greenriver, Utah, for 1905.

[Drainage area, 38,200 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
February 16-28	1,760	1,415	1,556	40,120	0.041	0.020
March	3,955	1,760	3,020	185,700	.079	.091
April	6,915	2,720	4,256	253,200	.111	.124
May	25,970	6,915	13,910	855,300	.364	.420
June	37,700	14,900	26,380	1,570,000	.691	.771
July	14,320	4,370	8,202	504,300	.215	.248
August	3,955	1,870	2,751	169,200	.072	.083
September	6,530	1,870	2,530	150,600	.066	.074
October	6,720	1,870	2,506	154,100	.066	.076
November	2,560	1,815	2,052	122,100	.054	.060
December 1-22	1,870	1,220	1,382	60,300	.036	.029
The period				4,065,000		

NEWFORK RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Newfork River and its tributaries drain a portion of the western slopes of the Wind River Range, extending from Fremont Peak southeastward to Mount Bonneville, Mount Geikie, and Twin Buttes. The main stream flows in a general southerly course to a point near Cora, Wyo., where it turns sharply to the southwest, joining Green River about 40 miles below.

The entire length of the Newfork does not exceed 50 miles. The basin as a whole is triangular in shape and comprises approximately 1,100 square miles. Forests, in some places dense, cover about 300 square miles. Pines predominate, but aspens and firs are also found.

Pine, Pole, and Boulder creeks and Eastfork River are the chief tributaries of the Newfork. These are all small streams, heading far back among the high peaks of the range and fed by the numerous springs and small mountain lakes with which the region is dotted. Fremont, Boulder, Fayette, Half Moon, Burnt, and Meadow lakes are the largest and most important of these. Fremont Lake, through which Pine Creek flows, has an area of approximately 2,500 acres. The outlet is narrow and a dam at this point might be made to raise the water surface about 30 feet. Such a dam would probably store all the surplus waters of the creek. Boulder Creek flows through Boulder Lake. The outlet of this lake also is narrow, and a dam to raise the surface of the lake about 5 feet is in process of construction. In the drainage area of Pole Creek there are said to be no less than 40 small settling basins.

The upper portion of all these streams is forested and the valleys and rolling bench lands are covered with sagebrush and a sparse growth of nutritious grasses. The soil of the foothill region is sandy and gravelly in character, gradually becoming a rich loam at the lower levels. Several ditches are taken out of Pine and Pole creeks and Eastfork River, and small areas of land are irrigated in a primitive way. The valley of Boulder Creek contains from 15,000 to 20,000 acres of the best agricultural land in the northern Green River basin. This could easily be watered from the creek, and diversion projects which contemplate the reclamation of the greater part of it are well under way.

NEWFORK RIVER NEAR CORA, WYO.

A temporary gaging station was established May 23, 1905, for the purpose of obtaining data in regard to the relative run-off of the stream and its tributaries. It is located at the "Pinedale Crossing," about 3 miles below Cora, in sec. 19, T. 34 N., R. 104 W.

The channel, though generally very winding, is straight for 150 feet above and 100 feet below the gage. The banks are not subject to overflow. The bed of the stream is composed of cobblestones and is permanent.

Discharge measurements are made by wading at a point 100 feet above or from a foot bridge 50 feet above the gage.

The gage was read at 5 p. m. six days each week (the Sunday reading being estimated) by J. J. Hansen, the mail carrier between Cora and Pinedale. The gage consists of a board nailed to a hewn timber, firmly braced by long poles to the left bank of the stream. The bench mark is the top of a stake driven into the ground 10 feet northeast of the gage, opposite the 3.50-foot mark on the gage

The station was discontinued August 31.

Discharge measurements of Newfork River near Cora, Wyo., in 1905.

Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 23	A. J. Parshall	25	19	1.32	2.10	25
May 25	do	25	19	.95	2.05	18
June 18	do	35	48	3.37	2.50	162
June 22	do	30	26	1.80	2.15	49
September 20	do	12	3.2	.62	1.90	2

Daily gage height, in feet, of Newfork River near Cora, Wyo., for 1905.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1	2.5	2.3	2.1	12	2.25	2.15	2.1	23	2.1	2.1	2.0
2	2.5	2.28	2.1	13	2.2	2.15	2.1	24	2.1	2.1	2.0
3	2.5	2.25	2.1	14	2.25	2.2	2.1	25	2.1	2.1	2.0
4	2.3	2.2	2.1	15	2.3	2.2	2.1	26	2.1	2.15	2.0
5	2.1	2.2	2.2	16	2.3	2.18	2.05	27	2.15	2.15	2.0
6	2.1	2.2	2.1	17	2.7	2.15	2.05	28	2.2	2.1	2.0
7	2.1	2.2	2.1	18	2.5	2.1	2.05	29	2.2	2.1	2.0
8	2.15	2.2	2.1	19	2.3	2.1	2.05	30	2.25	2.1	2.0
9	2.25	2.2	2.1	20	2.2	2.1	2.0	31		2.1	2.0
10	2.3	2.2	2.1	21	2.2	2.1	2.0				
11	2.28	2.2	2.1	22	2.15	2.1	2.0				

NOTE.—Sunday gage heights estimated.

PINE CREEK NEAR PINEDALE, WYO.

Pine Creek, designated on the eariler maps as Fremont Creek, rises on the southern face of Fremont Peak, near the top, and flows southwestward to its point of junction with Newfork River. Its length is about 25 miles. From its source to a point about 2 miles beyond Fremont Lake, through which it flows, it is a winding stream having a series of falls and rapids, almost impassable even at low water. Its drainage area comprises 130 square miles, about 60 square miles being covered with forest, more or less dense. Two diversion ditches are taken from the stream, and together these irrigate about 2,000 acres of grass land. Another canal of larger dimensions is contemplated to provide water for an additional 6,000 acres.

A gaging station was established on the stream April 25, 1904. It was located about one-fourth mile west of Pinedale, but this location not proving entirely satisfactory, it was abandoned at the close of the season, and April 2, 1905, it was reestablished near the Hansen ranch, 1 mile above Pinedale, in sec. 28, T. 34 N., R. 109 W.

The channel is comparatively straight for several hundred feet above and below the gage. The stream runs high in its banks, but does not overflow. The bed is rocky and permanent. There is but one channel, and this is unobstructed except during the winter months, when ice forms. The range of gage heights seldom exceeds 2 feet.

High-water measurements are made by means of a boat, a strong wire being stretched from bank to bank for use as an anchor. During low-water periods measurements are made by wading at a point 300 yards below the gage, where the bed of the channel is generally smoother.

The gage, which during 1905 was read daily by J. J. Hansen, is a vertical 10-inch round timber, set 1 foot deep into the rocky bottom of the channel and braced firmly to a large pine tree on the right bank. The bench mark is a spike driven into the tree opposite the 5-foot mark on the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 60–62.

Discharge measurements of Pine Creek near Pinedale, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29	A. J. Parshall	26	25	1.04	1.00	26
April 2	do	25	25	1.04	1.00	26
April 21	do	35	28	1.29	1.10	36
April 24	do	28	32	1.09	1.10	35
May 23	do	77	80	1.50	1.40	120
May 23 [a]	do	35	52	2.04	1.40	106
May 25	do	77	87	1.58	1.45	137
May 30	G. N. Stadin	78	118	2.07	1.65	244
June 18 [b]	A. J. Parshall	80	204	6.19	2.85	1,262
June 22 [b]	do	80	180	4.88	2.50	878
August 11	do	80	116	2.31	1.70	268
September 16	do	30	34	2.26	1.30	77
September 20	do	30	31	2.16	1.25	67

[a] Measured at a point 300 yards below station, below a diversion ditch.
[b] Measurements made from boat.

Daily gage height, in feet, of Pine Creek near Pinedale, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.0	1.15	1.7	2.8	2.0	1.45	1.2
2	1.0	1.15	1.8	2.8	1.9	1.45	1.2
3	1.0	1.2	1 9	2.8	1.9	1.45	1.2
4	1.0	1.2	2.0	2.8	1.85	1.45	1.25
5	1.0	1.2	2.2	2.75	1.8	1.4	1.2
6	1.0	1.2	2.35	2.75	1.8	1.4	1.2
7	1.0	1.2	2.4	2.7	1.8	1.4	1.2
8	1.0	1.2	2.5	2.7	1.8	1.4	1.2
9	1.0	1.2	2.6	2.7	1.75	1.4	1.2
10	1.0	1.2	2.7	2.7	1.75	1.4	1.2
11	1.0	1.2	2.7	2.7	1.7	1.4	1.2
12	1.0	1.2	2.6	2.7	1.7	1.4	1.2
13	1.0	1.25	2.7	2.65	1.65	1.4	1.15
14	1.0	1.25	2.8	2.6	1.6	1.35	1.15
15	1.0	1.2	2.8	2.6	1.6	1.35	1.15
16	1.0	1.2	2.8	2.6	1.6	1.35	1.15
17	1.0	1.2	2.9	2.6	1.6	1.35	1.15
18	1.1	1.25	2.9	2.6	1.6	1.3	1.15
19	1.05	1.25	2.8	2.6	1.55	1.3	1.15
20	1.05	1.3	2.7	2.4	1.55	1.3	1.15
21	1.1	1.3	2.6	2.35	1.55	1.25	1.15
22	1.1	1.3	2.5	2.35	1.5	1.25	1.1
23	1.1	1.4	2.5	2.3	1.5	1.25	1.1
24	1.1	1.4	2.5	2.3	1.5	1.25	1.1
25	1.1	1.5	2.5	2.2	1.5	1.25	1.1
26	1.1	1.5	2.5	2.15	1.5	1.25	1.1
27	1.1	1.55	2.6	2.15	1.5	1.25	1.1
28	1.1	1.6	2.7	2.1	1.5	1.25	1.1
29	1.1	1.6	2.7	2.1	1.5	1.2	1.1
30	1.1	1.7	2.8	2.1	1.5	1.2	1.1
31	.....	1.7	.....	2.0	1.5	.....	1.1

Station rating table for Pine Creek near Pinedale, Wyo., from March 29 to September 20, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	26	1.60	206	2.20	607	2.80	1,200
1.10	35	1.70	258	2.30	694	2.90	1,313
1.20	54	1.80	316	2.40	786	3.00	1,430
1.30	83	1.90	380	2.50	885		
1.40	118	2.00	451	2.60	986		
1.50	159	2.10	526	2.70	1,091		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made from March 29 to September 20, 1905, and is well defined.

Estimated monthly discharge of Pine Creek near Pinedale, Wyo.

[Drainage area, 130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	35	26	29.6	1,761	0.228	0.254
May	258	43	95.8	5,890	.737	.850
June	1,313	258	932	55,460	7.17	8.00
July	1,200	451	904	55,580	6.95	8.01
August	451	159	236	14,510	1.82	2.10
September	138	54	96.9	5,766	.745	.831
October	67	35	45.1	2,773	.347	.400
The period				141,700		

POLE CREEK AT FAYETTE, WYO.

Pole Creek rises on the southern and western slopes of Newfork Peak, flows southwestward, and unites with Newfork River about midway between the points where Pine Creek and Eastfork River join that stream. Like the other tributaries of the Newfork, it is a mountain stream, its source of supply being the direct drainage at its head and numerous small lakes and ponds, of which Fayette and Halfmoon lakes are the largest. The creek is about 25 miles in length. For the last 10 miles of its course it flows through a level or slightly undulating valley, varying from 1 mile to 3 miles in width, with a rich alluvial soil. Two diversion ditches, which provide water for the irrigation of about 3,700 acres of land, are taken from the creek.

The gaging station was established April 22, 1904. It is located at a point opposite and about 300 yards distant from Fayette post-office, in sec. 9, T. 33 N., R. 108 W.

The channel is straight for about 50 feet above and 100 feet below the station. The right bank is low, is covered with brush, and is liable to overflow. The left bank is high and clean and does not overflow. The bed is composed of cobblestones and sand and is stable. There is but one channel at low water; at high water there is one main channel and a small slough on each side. The slope of the channel is toward the left bank, and the current is swift. Gage heights have a range of nearly 3 feet. The creek seldom freezes entirely over owing to the velocity of the current and the numerous adjacent springs. There are no natural obstructions except such as are formed by the accumulations of ice among the willows that fringe the banks and extend back for a considerable distance.

At ordinary stages discharge measurements are made by wading at a point about 200 yards below the gage. High-water measurements are made by means of a boat swinging from a wire stretched taut directly across the channel from bank to bank.

The gage, which was read during 1905 by G. N. Stadin, is a vertical timber set 1 foot deep into the cobblestone bed of the stream and firmly braced to the left bank. For use during high-water stages a wire gage has been attached to the vertical gage in such a way as to extend about 3 feet out over the stream. The gage is referred to bench marks as follows: (1) The top of a 3-inch stake driven firmly into the ground about 10 feet from the gage and marked with a copper number "0;" elevation above the zero of the gage, 4.47 feet. (2) The top of a similar stake about 10 feet from the gage, marked with a copper number "7;" elevation, 5.02 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 62–65.

Discharge measurements of Pole Creek at Fayette, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 30	A. J. Parshall	31	24	0.79	1.00	19
April 21	do	35	29	.97	1.10	28
April 25	do	37	33	1.03	1.15	34
May 19	G. N. Studin	42	47	2.00	1.55	94
May 21	A. J. Parshall	65	50	2.05	1.65	101
May 23	do	70	71	2.72	2.00	193
May 24	do	70	85	2.93	2.15	249
May 25	do	70	94	3.01	2.25	283
May 30	G. N. Studin	70	101	3.43	2.50	346
June 15 [a]	A. J Parshall	70	155	5.13	3.00	795
June 16 [a]	do	70	156	5.29	3.05	826
June 17 [a]	do	70	163	5.58	3.15	910
June 20 [a]	do	70	131	4.50	2.80	590
June 21 [a]	do	70	122	4.18	2.70	510
June 22 [a]	do	70	114	3.98	2.65	454
August 9	do	44	49	1.88	1.60	92
August 13	do	43	47	1.79	1.55	84
September 17	do	35	29	.96	1.12	28
September 19	do	35	28	.93	1.10	26

[a] Discharge measurement made from boat.

Daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.0	1.25	2.45	2.85	1.85	1.3	1.0
2	1.0	1.30	2.55	2.85	1.85	1.3	1.0
3	1.0	1.4	2.55	2.7	1.85	1.3	1.0
4	1.0	1.4	2.7	2.7	1.85	1.3	1.0
5	1.0	1.4	2.9	2.6	1.85	1.3	1.0
6	1.0	1.4	2.1	2.6	1.8	1.3	.95
7	1.0	1.4	3.1	2.55	1.75	1.25	.95
8	1.0	1.4	3.2	2.55	1.7	1.25	1.0
9	1.0	1.4	3.15	2.45	1.7	1.25	1.0
10	1.0	1.45	3.2	2.4	1.65	1.25	1.0
11	1.0	1.45	3.3	2.4	1.6	1.25	1.0
12	1.0	1.45	3.2	2.4	1.6	1.2	1.0
13	1.0	1.45	3.0	2.4	1.6	1.2	1.0

Daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
14	1.05	1.45	2.85	2.4	1.6	1.2	1.0
15	1.05	1.45	3.0	2.4	1.6	1.15	1.0
16	1.05	1.45	3.0	2.4	1.5	1.15	.95
17	1.05	1.45	3.05	2.35	1.5	1.15	.95
18	1.1	1.45	3.1	2.3	1.5	1.1	.95
19	1.1	1.5	3.0	2.25	1.5	1.05	.95
20	1.1	1.55	2.85	2.25	1.5	1.05	.95
21	1.1	1.5	2.7	2.15	1.5	1.05	.95
22	1.05	1.8	2.65	2.1	1.4	1.05	.95
23	.95	2.0	2.65	2.05	1.4	1.05	.95
24	1.15	2.15	2.65	2.0	1.4	1.05	.95
25	1.15	2.25	2.65	2.0	1.4	1.05	.95
26	1.15	2.25	2.75	2.0	1.35	1.05	.95
27	1.15	2.35	2.85	1.95	1.35	1.0	.95
28	1.15	2.35	2.9	1.9	1.35	1.0	.95
29	1.15	2.35	2.85	1.9	1.35	1.0	.95
30	1.20	2.4	2.9	1.85	1.35	1.0	.95
31	.....	2.45	.....	1.8	1.35	.....	.95

Station rating table for Pole Creek at Fayette, Wyo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	19	1.60	94	2.20	255	2.80	590
1.10	27	1.70	114	2.30	293	2.90	680
1.20	36	1.80	137	2.40	335	3.00	775
1.30	47	1.90	162	2.50	383	3.10	875
1.40	60	2.00	190	2.60	440	3.20	980
1.50	76	2.10	221	2.70	510	3.30	1,085

NOTE.—The above table is applicable only for open-channel conditions. It is based on 19 discharge measurements made during 1905. It is well defined between gage heights 1 foot and 3.2 feet.

Estimated monthly discharge of Pole Creek at Fayette, Wyo., for 1905.

[Drainage area, 126 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	36	16	23.8	1,416	0.189	0.211
May	359	42	132	8,116	1.05	1.21
June	1,085	221	669	39,810	5.31	5.92
July	635	137	319	19,620	2.53	2.92
August	150	54	91.5	5,626	.726	.837
September	47	19	32.8	1,952	.260	.290
October	19	16	17.3	1,064	.137	.158
The period				77,600		

FALL CREEK NEAR FAYETTE, WYO.

Fall Creek, a small tributary of Pole Creek, joins the latter less than 2 miles from the point where it emerges from the foothills. It is fed by numerous springs and small mountain lakes and flows through Burnt Lake, which covers an area of 700 or 800 acres. The creek is about 15 miles long and drains an area of 60 square miles, of which almost one-third is forested. The entire basin is very rough. One small ditch is taken from it, conveying water upon the Pole Creek flats.

A gaging station was established April 22, 1904. It is located about 1 mile southeast of Fayette post-office, at the crossing of the Upper Boulder road, in sec. 10, T. 33 N., R. 108 W.

The channel is straight for about 40 feet above and 50 feet below the station. The banks are high and are not liable to overflow. The bed of the stream is composed of cobblestones and gravel and is smooth. The current is swift except at very low water, when it becomes sluggish. There is but one channel at all stages. Early in 1905 some large cobblestones, which at low water protruded from the riffles below the gage, were removed, and the rating curve for 1905 is therefore slightly different from that for 1904. Gage heights have a range of almost 2 feet. The stream is frozen solid during the winter months.

Discharge measurements are made at low and ordinary stages by wading, and at high water by means of a boat, the initial point for soundings being the left bank at the gage. At extreme low water a section 200 yards below the gage is chosen.

The gage, which was read during 1905 by G. N. Stadin, is a vertical timber set in the bed of the stream and firmly braced to the left bank. The bench mark is a cross on the highest point of a stone about 1 foot in diameter planted firmly in the ground 10 feet from the gage and surrounded by smaller stones. Elevation above the zero of the gage, 4.63 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 65–67.

Discharge measurements of Fall Creek near Fayette, Wyo., in 1905.

Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft*
April 21	A. J. Parshall	31	19	0.74	1.35	14
April 25	do	30	22	.64	1.35	14
May 21	do	34	27	1.30	1.55	35
May 23	do	35	38	1.90	1.73	72
May 24	do	35	39	2.05	1.80	80
May 30	G. N. Stadin	37	47	2.83	2.00	133
June 16	A. J. Parshall	37	72	4.53	2.70	326
June 19	do	37	62	3.61	2.35	224
Do	do	55	60	3.50	2.35	210
June 20	do	37	55	3.27	2.15	180
August 9	do	33	26	1.04	1.48	27
August 13	do	33	24	.87	1.42	21
September 17	do	12	4.2	.86	1.18	3.6
September 19	do	12	4.8	.69	1.15	3.3

Daily gage height, in feet, of Fall Creek near Fayette, Wyo., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.4	2.1	2.85	1.6	1.3	1.15	17	1.4	2.7	1.95	1.4	1.2	1.15
2	1.4	2.2	2.85	1.6	1.3	1.15	18	1.45	2.65	1.9	1.4	1.15	1.15
3	1.4	2.4	2.7	1.6	1.3	1.15	19	1.45	2.3	1.9	1.4	1.15	1.15
4	1.4	2.6	2.4	1.6	1.3	1.15	20	1.5	2.2	1.9	1.4	1.15	1.15
5	1.4	2.7	2.25	1.6	1.3	1.15	21	1.5	2.25	1.85	1.35	1.15	1.15
6	1.4	2.8	2.15	1.6	1.25	1.15	22	1.65	2.15	1.8	1.35	1.15	1.15
7	1.4	2.75	2.1	1.55	1.25	1.15	23	1.75	2.2	1.7	1.35	1.15	1.15
8	1.4	2.7	2.0	1.55	1.25	1.1	24	1.8	2.2	1.7	1.35	1.15	1.15
9	1.4	2.85	1.9	1.5	1.25	1.1	25	1.8	2.2	1.7	1.3	1.15	1.15
10	1.4	2.9	1.95	1.5	1.25	1.1	26	1.9	2.4	1.6	1.3	1.1	1.15
11	1.4	2.5	1.95	1.45	1.25	1.1	27	2.0	2.45	1.6	1.3	1.1	1.15
12	1.4	2.5	1.95	1.45	1.25	1.1	28	2.0	2.3	1.6	1.3	1.1	1.15
13	1.4	2.4	1.95	1.4	1.25	1.1	29	2.1	2.3	1.65	1.3	1.1	1.15
14	1.4	2.4	1.95	1.4	1.2	1.1	30	2.1	2.3	1.65	1.3	1.1	1.15
15	1.4	2.5	1.95	1.4	1.2	1.15	31	2.1	.....	1.65	1.3	.....	1.15
16	1.4	2.65	1.95	1.4	1.2	1.15							

Station rating table for Fall Creek near Fayette, Wyo., from May 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	2	1.60	46	2.10	157	2.60	293
1.20	5	1.70	65	2.20	183	2.70	321
1.30	10	1.80	86	2.30	209	2.80	350
1.40	18	1.90	108	2.40	237	2.90	380
1.50	31	2.00	132	2.50	265	3.00	410

NOTE.—The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made from April 21 to September 19, 1905.

Estimated monthly discharge of Fall Creek near Fayette, Wyo., for 1905.

[Drainage area, 60 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May	157	18	50.4	3,099	0.840	0.968
June	380	157	252	15,000	4.20	4.69
July	365	46	130	7,993	2.17	2.50
August	46	10	23.5	1,445	.392	.452
September	10	2	5.33	317	.089	.099
October	3	2	2.77	170	.046	.053
The period	.....	.....	.....	28,020	.....	.....

BOULDER CREEK NEAR BOULDER, WYO.

Boulder Creek rises in the vicinity of Mounts Bonneville and Geikie, in the Wind River Mountains, flows westward through Boulder Lake, then turns to the southwest and unites with Newfork River 3 miles above the point where the latter stream is joined by the East-fork. Numerous small mountain lakes, scattered over an area 5 or 6 miles square, contribute their drainage to the creek near its head. Boulder Lake, the largest of these, lies at an elevation of 7,200 feet and its water surface is estimated to cover 1,500 acres. The total area of the basin is 160 square miles and approximately one-third of this is timbered. The upper two-thirds of the basin is very rough; but the lower third is a gently sloping flat, which contains 15,000 to 20,000 acres of excellent agricultural land.

The gaging station was established April 23, 1904. It is located at the Coolidge ranch, about 1½ miles northeast of Boulder post-office, in sec. 4, T. 32 N., R. 108 W., and is below all diversion ditches. In the 1904 Progress Report this station was given as Boulder Creek near Newfork, Wyo.

The channel is nearly straight for about 300 feet above and below the station. The right bank is low and is covered with brush and small trees, but is liable to overflow for a short distance only; the left bank is high and can not overflow. The bed of the stream is composed of cobblestones and sand and is stable. There is but one channel at all stages, and this slopes toward the left bank. The current is swift at high water, but becomes sluggish at low stages. Gage heights have a range of about 4 feet. The stream freezes solid during the winter months. Early in 1905 the larger rocks and some sunken driftwood opposite the gage were removed, slightly changing the cross section and the value of the gage heights on the discharge curve.

Discharge measurements are made by wading at the station until the water rises to about the 2-foot mark on the gage, when the wooden highway bridge, 2 miles below, is used. The initial point for soundings is at the gage.

The gage, which was read during 1905 by T. J. Coolidge, is a timber firmly set in the bed of the stream and braced to a tree and stump on the left bank. The bench mark is a spike driven in a stump opposite the 4-foot mark on the gage and 3 feet distant.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 67–69.

Discharge measurements of Boulder Creek near Boulder, Wyo.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 22[a]	A. J. Parshall	25	25	1.56	0.50	39
May 22	do	64	122	1.76	1.10	215
May 24	do	67	155	2.51	1.60	389
May 24[b]	do	57	161	2.45	1.60	394
May 28[b]	G. N. Stadin	60	191	2.79	1.90	533
June 16[b]	A. J. Parshall	81	331	5.33	3.90	1,763
June 19[b]	do	81	300	3.37	2.80	1,011
June 21[b]	do	80	268	2.99	2.40	800
June 24[b]	G. N. Stadin	81	301	3.89	3.00	1,172
August 10	A. J. Parshall	60	94	.98	.75	92
August 12	do	60	86	.86	.70	74
September 18	do	55	46	.39	.30	18

[a] Measured at point 100 yards above station. [b] Measured at bridge 2 miles below station.

Daily gage height, in feet, of Boulder Creek near Boulder, Wyo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	0.5	2.15	3.0	0.92	0.45	0.2
2	.....	.5	2.6	3.0	.9	.45	.2
3	.....	.6	2.98	2.78	.88	.45	.2
4	.....	.6	3.42	2.4	.82	.45	.2
5	.....	.6	3.92	2.4	.8	.45	.2
6	.....	.6	3.72	2.4	.8	.45	.2
7	.....	.6	3.55	2.38	.8	.42	.2
8	.....	.6	3.85	2.3	.78	.42	.2
9	.....	.6	4.15	2.3	.72	.4	.2
10	.....	.6	3.95	2.18	.7	.4	.2
11	.....	.6	3.35	2.12	.7	.4	.2
12	.....	.6	3.08	2.05	.7	.4	.2
13	.....	.6	3.25	2.02	.7	.4	.2
14	.....	.6	3.72	1.95	.65	.4	.2
15	0.5	.6	3.95	1.95	.6	.4	.2
16	.5	.6	3.88	1.95	.6	.4	.2
17	.5	.65	3.65	1.98	.6	.38	.2
18	.5	.72	3.25	1.85	.58	.3	.2
19	.5	.82	2.85	1.65	.55	.3	.2
20	.5	.92	2.45	1.5	.5	.3	.2
21	.5	1.0	2.40	1.5	.5	.28	.2
22	.5	1.1	2.55	1.45	.48	.25	.2
23	.5	1.3	2.8	1.38	.45	.25	.2
24	.5	1.6	3.08	1.3	.45	.25	.2
25	.5	1.68	3.2	1.25	.45	.25	.2
26	.5	1.75	3.22	1.2	.45	.25	.2
27	.5	1.8	3.35	1.2	.45	.25	.2
28	.5	1.9	3.42	1.18	.45	.22	.2
29	.5	1.9	3.4	1.12	.5	.2	.2
30	.5	1.9	3.15	1.02	.5	.2	.2
31	.....	1.85	.....	1.0	.5	.....	.2

Station rating table for Boulder Creek near Boulder, Wyo., from April 15, to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	9	1.10	189	2.00	594	2.90	1,097
.30	18	1.20	224	2.10	644	3.00	1,160
.40	29	1.30	263	2.20	695	3.20	1,289
.50	42	1.40	304	2.30	747	3.40	1,421
.60	58	1.50	349	2.40	800	3.60	1,557
.70	77	1.60	396	2.50	855	3.80	1,695
.80	100	1.70	444	2.60	913	4.00	1,835
.90	127	1.80	494	2.70	973	4.20	1,975
1.00	157	1.90	544	2.80	1,035		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is well defined between gage heights 0.5 foot and 3 feet.

Estimated monthly discharge of Boulder Creek near Boulder, Wyo., for 1905.

[Drainage area, 155 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 15-31	42	42	42	1,333	0.271	0.161
May	544	42	188	11,560	1.21	1.40
June	1,940	913	1,350	80,330	8.71	9.72
July	1,160	157	543	33,390	3.50	4.04
August	133	35	64.5	3,966	.416	.480
September	35	9	23.6	1,404	.152	.170
October	9	9	9.0	553	.058	.067
The period				132,500		

EASTFORK RIVER AT NEWFORK, WYO.

Eastfork River, the southernmost as well as the largest of the tributaries of the Newfork, is formed by the three small creeks which drain its upper basin. Two of these, Silver and Willow creeks, head among the small mountain lakes about Twin Butte and on the southern slopes of Mount Geikie, at an elevation of about 9,000 feet; the third, Muddy Creek, is a spring stream and heads at a somewhat lower elevation farther to the south. The total area of the Eastfork basin is about 320 square miles, and perhaps 2 per cent of this is forested. The upper portion of the basin is the broken, rugged country of the mountains; farther down the valley opens out into broad, level stretches, with a gradual slope to the west. The soil is a sandy loam, well covered in its natural condition with a heavy growth of sagebrush and a smaller quantity of nutritious grasses. Irrigation is practiced in a primitive way, a few small diversion ditches taking water out upon lowland meadows.

A gaging station was established April 1, 1905. It is located at a point about one-third mile southeast of Newfork post-office, in sec. 34, T. 32 N., R. 108 W., and about one-fourth mile above the county highway bridge across Eastfork, near the Noble ranch house.

There is but one channel and the banks are not liable to overflow. The bed of the stream is sandy and shifting, and the section is less satisfactory than was supposed when the gage was installed. Gage heights have a range of about 4 feet. The bed at the highway bridge is less changeable and furnishes a better section than that first selected, though it is divided into three channels by the piling. The river freezes solid during the later months of the winter.

During the lower stages discharge measurements are made by wading at the station, the initial point for soundings being the bench mark. At high water, when the gage reads above 2.5 feet, measurements are made from the highway bridge, which is a three-span wooden structure, resting upon piling protected by rock at the bottom.

The gage, which during 1905 was read daily by Mrs. Cora Noble, is a vertical timber, firmly braced to the right bank. The bench mark is a copper "0" on the top of a post set in the ground 10 feet west of the gage; elevation, 5.68 feet above the zero of the gage.

Discharge measurements of Eastfork River at Newfork, Wyo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft*
April 22	A. J. Parshall	81	64	0.69	0.30	44
May 22	do	95	228	2.18	1.92	498
Do	do	95	246	2.35	2.13	577
May 24 [a]	do	75	238	2.84	2.40	675
May 28 [a]	G. N. Stadin	75	274	3.31	2.65	907
June 16 [a]	A. J. Parshall	75	324	4.26	3.35	1,381
June 19 [a]	do	75	259	2.97	2.50	769
June 21 [a]	do	75	215	2.40	2.00	516
June 24 [a]	G. N. Stadin	75	272	2.84	2.45	772
August 10	A. J. Parshall	85	80	.67	.40	54
August 12	do	83	71	.68	.35	48
September 18 [b]	do	64	54	.63	.20	34

[a] Discharge measurement made at bridge below station.
[b] Discharge measurement made 100 yards below station.

Daily gage height, in feet, of Eastfork River at Newfork, Wyo., for 1905.

Day.	Apr.	May.	June.	July	Aug.	Sept	Oct.
1	1.6	0.5	3.1	1.65	0.4	0.3	0.2
2	1.6	.5	3.8	1.6	.4	.3	.2
3	1.6	.5	4.0	1.3	.4	.3	.2
4	1.6	.5	4.55	1.2	.4	.3	.2
5	1.8	.4	4.9	1.1	.4	.3	.2
6	1.2	.4	3.7	1.1	.4	.3	.2
7	.9	.4	3.5	1.0	.4	.3	.2
8	.9	.4	4.2	1.0	.4	.3	.2
9	.9	.5	4.4	1.0	.4	.2	.2
10	.8	.5	3.7	.9	.4	.2	.2
11	.5	.5	2.85	.9	.3	.2	.2
12	.4	.5	2.95	.8	.3	.2	.2
13	.4	.5	3.25	.8	.3	.2	.2
14	.4	.4	3.75	.8	.3	.2	.2
15	.4	.4	3.5	.8	.3	.2	.2
16	.4	.5	3.35	1.0	.3	.2	.2
17	.4	.6	3.3	1.0	.3	.2	.2
18	.3	1.0	2.95	.8	.3	.2	.2
19	.3	1.0	2.35	.6	.3	.2	.2
20	.3	1.4	2.1	.5	.3	.2	.2
21	.3	1.7	2.05	.5	.3	.2	.2
22	.3	2.0	2.4	.5	.3	.2	.2
23	.3	2.3	2.55	.6	.3	.2	.2
24	.3	2.3	2.55	.6	.3	.2	.2
25	.3	2.2	2.45	.5	.3	.2	.2
26	.4	2.2	2.6	.5	.3	.2	.2
27	.4	2.55	2.35	.5	.3	.2	.2
28	.4	2.55	2.3	.5	.3	.2	.2
29	.4	2.3	2.0	.4	.3	.2	.6
30	.4	2.05	1.6	.4	.3	.2	.8
31	.....	2.2	.....	.5	.3	.....	.3

Station rating table for Eastfork River at Newfork, Wyo., from May 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	30	1.00	181	1.80	445	2.60	851
.30	43	1.10	208	1.90	485	2.70	914
.40	58	1.20	236	2.00	527	2.80	979
.50	75	1.30	267	2.10	572	2.90	1,046
.60	93	1.40	300	2.20	621	3.00	1,115
.70	112	1.50	334	2.30	674	3.10	1,262
.80	133	1.60	370	2.40	731		
.90	156	1.70	407	2.50	790		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is fairly well defined between gage heights 0.2 foot and 2.6 feet. The table has been extended beyond these limits. Above gage height 3.20 feet the rating curve is a tangent, the difference being 76 per tenth.

Estimated monthly discharge of Eastfork River at Newfork, Wyo., for 1905.

[Drainage area, 320 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	445	43	127	7,557	0.397	0.443
May	820	58	286	17,580	.894	1.03
June	2,554	370	1,234	73,430	3.86	4.31
July	388	58	147	9,039	.459	.529
August	58	43	47.8	2,939	.149	.172
September	43	30	33.5	1,993	.105	.117
October	133	30	35.8	2,201	.112	.129
The period				114,700		

YAMPA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yampa River rises in Egeria Park, in the southeastern part of Routt County, Colo., runs in a general northerly direction to Steamboat Springs, and thence westward to its point of junction with Green River, just east of the Colorado-Utah State boundary. Throughout almost its entire course it flows in a succession of open valleys alternating with deep, narrow canyons, the longest and deepest of the canyons being that through which it enters the Green.

The drainage basin of the river lies for the most part within the boundaries of Routt County, which is a little larger than the State of Massachusetts and comprises about 6,000 square miles. Its eastern limit is formed by the Park Mountains, and the melting of the snows on their high peaks is the source of numerous small streams whose waters augment the volume of the river and form its chief perennial supply. Westward from the mountains the basin is largely the eroded and dissected Yampa Plateau, whose wide terraces, abrupt cliffs, and deep-cut gulches and arroyos are the striking features of the region. The general level is over 6,000 feet above sea.

The rocks of the basin are largely of sedimentary origin and embrace chiefly formations of Tertiary and Cretaceous periods. The soils derived from these rocks are friable and soft, with considerable alkali, and large tracts are covered with sagebrush. The forests in the mountainous portion of the basin are composed of coniferous trees, and scattered clumps of piñon and cedars are found in the plateau country. Weather Bureau records show the mean annual precipitation at the town of Lay to be 12.35 inches.

Elk River, Fortification Creek, Elk Head Creek, William River, and Little Snake River are the most important tributaries of the Yampa. The upper basins of these streams are within the forested region, but along their lower courses are many cultivated areas.

Irrigation in the Yampa basin is confined to low bottom lands and scattered first-bench lands, but a number of systems are now under consideration.

YAMPA RIVER AT STEAMBOAT SPRINGS, COLO.

This station was established May 3, 1904, at the highway bridge at the east end of Steamboat Springs. May 8, 1905, it was reestablished at the new steel highway bridge, about one-fourth mile below the old bridge, in sec. 17, T. 6 N., R. 84 W.

The channel is straight for about 400 feet above and below the station. The left bank is low, but a roadway about 8 feet high leading to the bridge prevents any overflow. The left bank is high and practically clean. The stream does not overflow even at extremely high stages. The bed is composed of rock and gravel, with some sand, and is clean and permanent. There is but one channel at all stages, obstructed to some extent by several large bowlders. The current is swift at high and medium at low stages. Gage heights have a range of about 4.5 feet. Ice conditions during the winter months render gage readings impracticable.

Discharge measurements are made from the upstream side of the single-span bridge, to which the gage is attached. A stay line is used to keep the meter in position during measurements of high stages. The initial point for soundings is the upstream side of the left abutment, marked zero.

A standard chain gage, which was read twice each day during 1905 by Elmer Brightman, is attached to the downstream side of the bridge, 35 feet from the left abutment. The length of the chain is 13.43 feet. The gage is referred to bench marks as follows: (1) The top of the west side of the left abutment of the bridge; elevation 11.50 feet above the zero of the gage. (2) A standard United States Geological Survey iron post, located 100 feet south of the left end of the old wooden bridge, one-fourth mile up the river; elevation, 15.65 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 70–72.

Discharge measurements of Yampa River at Steamboat Springs, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 8	H. G. Graham	98	334	2.05	4.50	684
May 9	do	92	220	3.71	5.60	816
June 10	Hinderlider and Graham	97	447	7.36	8.15	3,290
Do	do	97	421	7.65	7.90	3,220
July 26	H. G. Graham	81	88	1.45	4.25	128
August 26	do	81	63	.75	4.00	47

Daily gage height, in feet, of Yampa River, at Steamboat Springs, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.65	4.95	7.5	5.15	4.38	4.0	4.18
2	3.65	5.0	7.7	5.65	4.3	4.0	4.18
3	3.65	4.9	7.85	5.4	4.3	4.0	4.1
4	3.7	4.65	8.4	5.15	4.25	4.0	4.1
5	3.75	4.55	8.7	5.05	4.18	4.02	4.1
6	3.75	4.15	8.25	4.9	4.2	4.15	4.1
7	3.75	4.45	8.6	4.8	4.22	4.18	4.08
8	3.75	4.55	8.68	4.72	4.18	4.18	4.08
9	3.8	4.75	8.68	4.68	4.15	4.12	4.08
10	4.05	5.65	8.15	4.65	4.2	4.1	4.08
11	4.05	5.62	8.65	4.52	4.25	4.1	4.08
12	4.0	5.6	7.75	4.52	4.38	4.02	4.08
13	4.05	5.48	7.75	4.42	4.32	4.1	4.08
14	4.05	5.38	7.5	4.42	4.25	4.1	4.08
15	4.0	5.32	7.65	4.42	4.18	4.08	4.08
16	4.15	5.55	7.3	4.32	4.15	4.02	4.08
17	4.15	5.75	7.08	4.32	4.12	4.02	4.08
18	4.25	6.05	7.02	4.3	4.02	4.02	4.08
19	4.25	6.22	6.85	4.3	4.0	4.02	4.08
20	4.25	6.45	6.8	4.32	4.0	4.08	4.12
21	4.15	6.75	6.72	4.3	4.0	4.08	4.18
22	4.15	6.85	6.72	4.28	4.0	4.08	4.18
23	4.15	7.1	6.35	4.25	4.0	4.02	4.18
24	4.15	7.25	6.2	4.18	4.0	4.02	4.18
25	4.15	6.95	6.0	4.15	4.0	4.08	4.18
26	4.15	7.02	5.88	4.12	4.0	4.08	4.18
27	4.25	6.95	5.65	4.18	4.0	4.08	4.18
28	4.3	6.95	5.5	4.32	4.0	4.08	4.18
29	4.35	6.8	5.4	4.35	4.0	4.1	4.18
30	4.75	6.82	5.2	4.35	3.98	4.18	4.18
31	.....	6.95	.....	4.38	4.0	.....	4.18

Station rating table for Yampa River at Steamboat Springs, Colo., from April 1 to May 18, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	130	4.10	440	5.00	935	5.90	1,640
3.30	146	4.20	485	5.10	.000	6.00	1,740
3.40	170	4.30	530	5.20	1,070	6.20	1,940
3.50	200	4.40	580	5.30	1,145	6.40	2,150
3.60	232	4.50	630	5.40	1,220	6.60	2,370
3.70	268	4.60	685	5.50	1,300	6.80	2,610
3.80	307	4.70	745	5.60	1,380	7.00	2,850
3.90	350	4.80	805	5.70	1,465	7.20	3,110
4.00	395	4.90	870	5.80	1,550	7.40	3,400

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1904, and is fairly well defined.

Station rating table for Yampa River at Steamboat Springs, Colo., from May 19 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	35	4.90	395	5.90	1,025	6.90	1,920
4.00	55	5.00	445	6.00	1,105	7.00	2,030
4.10	80	5.10	495	6.10	1,185	7.20	2,260
4.20	110	5.20	550	6.20	1,270	7.40	2,500
4.30	145	5.30	610	6.30	1,355	7.60	2,750
4.40	180	5.40	675	6.40	1,445	7.80	3,010
4.50	220	5.50	740	6.50	1,535	8.00	3,270
4.60	260	5.60	805	6.60	1,625	8.20	3,540
4.70	305	5.70	875	6.70	1,720	8.40	3,820
4.80	350	5.80	950	6.80	1,820	8.60	4,100

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905, and is fairly well defined.

Estimated monthly discharge of Yampa River at Steamboat Springs, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	775	250	418	24,870
May	2,320	462	1,405	86,390
June	4,240	550	2,435	144,900
July	840	86	254	15,620
August	173	51	92.5	5,688
September	104	55	73.1	4,350
October	104	75	88.2	5,423
The period				287,200

YAMPA RIVER NEAR CRAIG, COLO.

This station was established April 30, 1904. It is located on the wagon bridge 1 mile south of Craig, on the road to Meeker, Colo., in sec. 6, T. 6 N., R. 90 W., just below the mouth of Fortification Creek and about 7 miles above the mouth of Williams River.

The channel is straight for 250 feet above and 300 feet below the station. Both banks are low and overflow at extremely high stages. The bed of the stream is composed of sand, gravel, and cobblestones, and is permanent. There is but one channel at all ordinary stages, broken by the piers of the bridge; at high stages the stream flows through the culverts at each end of the bridge, and the current is materially broken by the driftwood which invariably collects at the upper side of the piers. The current is swift at high, but very sluggish at low water. Gage heights have a range of about 6 feet during an ordinary season. Ice in the channel renders gage readings impracticable during the winter months.

Discharge measurements are made from the downstream side of the three-span tubular steel pier bridge. The initial point for soundings is the vertical wall of the old log abutment on the left bank, to which the gage is attached.

The gage, which was read twice each day during 1905 by Lawson Thompson, is a vertical timber 12 feet long, fastened to a pile on the old log abutment at the left end of the bridge. The gage is referred to bench marks as follows: (1) The top of a bolt marked with a cross on the top of the tubular steel and concrete pier on the downstream side of the left abutment

of the bridge; elevation, 14.34 feet above the zero of the gage. (2) The top of a bolt marked with a cross on the top of the corresponding pier on the upstream side of the bridge; elevation, 14.37 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 72–74.

Discharge measurements of Yampa River near Craig, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 5	H. G. Graham	181	913	2.83	4.75	2,588
June 8	Hinderlider, Graham, and Hoyt	204	1,474	4.91	7.72	7,234
July 24	H. G. Graham	123	545	.82	2.70	445
August 25	do	122	447	.33	1.95	146
August 27	do	122	441	.32	1.95	139

Daily gage height, in feet, of Yampa River near Craig, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.8	5.6	6.75	4.55	2.6	1.8	2.0
2	3.05	5.85	7.15	4.45	2.65	1.8	2.0
3	2.9	5.55	7.15	4.7	2.6	1.8	2.0
4	2.85	5.05	7.45	4.55	2.65	1.8	2.0
5	2.75	4.65	8.05	4.35	2.6	1.8	2.0
6	2.85	4.5	8.0	4.1	2.85	1.8	2.0
7	3.35	4.35	7.45	3.8	2.85	1.8	2.0
8	3.7	4.5	7.6	3.8	2.85	1.95	2.0
9	4.15	5.15	7.8	3.7	2.85	2.2	2.0
10	4.35	5.25	8.1	3.65	2.85	2.2	2.0
11	4.05	4.8	7.55	3.6	2.65	2.2	2.0
12	3.8	4.65	7.35	3.55	2.55	1.9	1.9
13	3.8	4.6	7.0	3.5	2.5	1.9	1.9
14	4.25	4.7	7.2	3.4	2.4	1.9	1.9
15	3.8	4.55	6.9	3.4	2.35	1.8	2.0
16	3.8	4.8	6.95	3.25	2.4	1.8	2.0
17	3.95	4.75	6.7	3.15	2.4	1.8	2.0
18	4.15	5.7	6.4	2.95	2.4	1.8	2.1
19	4.4	6.3	6.25	2.9	2.45	1.8	2.0
20	4.4	6.65	6.0	2.95	2.4	1.8	2.0
21	4.25	6.8	5.8	2.9	2.25	1.85	2.0
22	4.15	7.15	5.75	2.9	2.25	1.9	2.0
23	4.2	7.4	5.9	2.75	2.3	1.9	2.0
24	4.4	7.7	5.75	2.7	2.15	1.8	2.1
25	4.35	7.45	5.55	2.55	1.95	1.9	2.1
26	4.35	7.0	5.45	2.6	1.9	1.9	2.0
27	4.65	6.95	5.3	2.6	1.9	1.9	2.1
28	5.1	6.9	5.0	2.55	1.9	1.9	2.1
29	5.25	6.75	4.9	2.5	1.9	1.9	2.1
30	5.4	6.35	4.75	2.5	1.9	1.9	2.15
31	.....	6.25	.....	2.5	1.8	.....	2.2

Station rating table for Yampa River near Craig, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	100	3.00	670	4.20	1,750	5.80	4,040
1.90	125	3.10	740	4.30	1,860	6.00	4,390
2.00	155	3.20	810	4.40	1,980	6.20	4,750
2.10	190	3.30	890	4.50	2,100	6.40	5,130
2.20	230	3.40	970	4.60	2,230	6.60	5,520
2.30	270	3.50	1,060	4.70	2,360	6.80	5,930
2.40	320	3.60	1,150	4.80	2,490	7.00	6,360
2.50	370	3.70	1,240	4.90	2,630	7.50	7,520
2.60	420	3.80	1,330	5.00	2,770	8.00	8,750
2.70	480	3.90	1,430	5.20	3,070		
2.80	540	4.00	1,530	5.40	3,380		
2.90	600	4.10	1,640	5.60	3,700		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is well defined between gage heights 1.9 feet and 4.8 feet.

Estimated monthly discharge of Yampa River near Craig, Colo., for 1905.

[Drainage area, 1,730 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	3,380	510	1,579	93,960	0.913	1.02
May	8,000	1,920	4,177	256,800	2.41	2.78
June	9,000	2,425	5,713	339,900	3.30	3.68
July	2,360	370	1,002	61,610	.579	.668
August	570	100	333	20,480	.192	.221
September	230	100	124	7,379	.072	.080
October	230	125	163	10,020	0.94	.108
The period				790,100		

YAMPA RIVER NEAR MAYBELL, COLO.

This station was established April 17, 1904. It is located at the Thornburg bridge, 10 miles west of Maybell and 75 miles from Meeker, Colo., in sec. 19, T. 7 N., R. 96 W.

The channel is straight for about 300 feet above and 600 feet below the station. The left bank is low and clean and overflows to a considerable extent during high water. The right bank is high and clean and is not subject to overflow. The bed of the stream is composed of gravel and sand and is shifting. Ice conditions render gage readings impracticable during the winter months. The ordinary range of gage heights is about 6 feet.

Discharge measurements are made from the downstream side of the two-span bridge to which the gage is fastened. The initial point for soundings is the edge of the left abutment.

The gage, which was read twice each day during 1905 by Peter Farrell, is a staff fastened to the left downstream edge of the middle pier of the bridge. The bench mark is a United States Geological Survey standard bronze tablet set in the top stone of the right abutment on the downstream side; elevation above the zero of the gage, 10.79 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 75-77.

Discharge measurements of Yampa River near Maybell, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
May 24	H. G. Graham	210	1,623	5.64	6.20	9,154
May 25	do	210	1,645	5.53	6.25	9,097
May 27	do	210	1,496	5.23	5.60	7,824
June 25	do	207	1,165	4.03	4.20	4,689
June 26	do	206	1,099	3.72	3.90	4,086
Aug. 18	do	172	409	.56	.45	229

Daily gage height, in feet, of Yampa River near Maybell, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.3	3.9	5.8	2.4	1.55	0.1	0.3
2	1.35	4.2	6.0	2.25	1.2	.15	.25
3	1.5	4.3	5.85	2.65	1.2	.15	.3
4	1.45	4.1	5.9	2.4	1.25	.2	.35
5	1.25	4.1	6.0	2.4	1.15	.18	.3
6	1.35	3.5	6.1	2.4	.95	.4	.25
7	1.5	4.05	6.2	2.3	.95	.3	.2
8	1.65	4.1	6.75	2.2	.8	.35	.25
9	2.05	3.9	5.85	1.95	.7	.3	.2
10	2.65	3.75	5.5	1.75	.5	.45	.2
11	2.5	3.4	5.95	1.7	.55	.35	.3
12	2.4	3.4	6.5	1.5	.4	.4	.3
13	2.75	3.3	6.6	1.5	.45	.25	.2
14	2.75	3.55	6.65	1.4	.4	.28	.25
15	2.65	3.3	6.4	1.35	.2	.35	.3
16	2.55	3.4	5.55	1.45	.3	.3	.4
17	2.65	3.6	4.75	1.3	.25	.22	.3
18	2.6	4.1	4.55	1.25	.35	.2	.3
19	2.75	4.95	4.45	1.25	.4	.22	.2
20	2.8	5.55	4.35	1.15	.35	.2	.3
21	2.55	5.8	4.4	1.1	.35	.2	.55
22	2.6	5.85	4.2	1.35	.3	.25	.4
23	2.75	6.25	4.25	1.1	.15	.35	.3
24	2.8	6.25	4.45	1.05	.3	.28	.3
25	2.65	6.25	4.05	.9	.25	.25	.15
26	3.05	5.75	3.9	1.2	.15	.3	.2
27	3.1	5.65	3.75	1.15	.2	.4	.25
28	3.4	5.7	3.4	1.05	.25	.35	.35
29	3.35	5.9	3.3	1.15	.2	.25	.4
30	3.75	5.9	3.15	1.3	.2	.25	.3
31	.....	5.7	.....	1.5	.2	.....	.25

Station rating table for Yampa River near Maybell, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.00	100	1.30	690	2.60	1,950	3.90	3,920
.10	130	1.40	760	2.70	2,080	4.00	4,100
.20	160	1.50	840	2.80	2,210	4.20	4,470
.30	190	1.60	920	2.90	2,340	4.40	4,860
.40	230	1.70	1,000	3.00	2,480	4.60	5,270
.50	270	1.80	1,090	3.10	2,620	4.80	5,710
.60	310	1.90	1,180	3.20	2,770	5.00	6,170
.70	350	2.00	1,280	3.30	2,920	5.20	6,640
.80	400	2.10	1,380	3.40	3,080	5.40	7,120
.90	450	2.20	1,490	3.50	3,240	5.60	7,610
1.00	500	2.30	1,600	3.60	3,400	5.80	8,110
1.10	560	2.40	1,710	3.70	3,570	6.00	8,630
1.20	620	2.50	1,830	3.80	3,740	6.50	10,070

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905, and it is well defined.

Estimated monthly discharge of Yampa River near Maybell, Colo., for 1905.

[Drainage area, 3,670 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	3,655	655	1,825	108,600	0.497	0.554
May	9,325	2,920	5,581	343,200	1.52	.75
June	10,850	2,695	6,768	402,700	1.84	05
July	2,015	450	968	59,520	.264	304
August	880	145	303	18,630	.083	096
September	250	130	185	11,010	.050	056
October	290	145	188	11,560	.051	.059
The period				955,200		

ELK RIVER NEAR TRULL, COLO.

Elk River rises in the northeastern part of Routt County, Colo., flows southward, and joins Yampa River 6 miles below Steamboat Springs. The drainage basin comprises the western slope of the Park Range and the greater part of it is mountainous, but there is some open prairie land along the river and its larger tributaries. Much of this prairie land is under cultivation, being irrigated by numerous ditches from the streams. Hay is the principal crop, but in the lower portion of the valley cereals are raised to some extent. The higher portions of the basin are covered by heavy forests of pine and spruce. Precipitation consists principally of snow during the winter months.

The gaging station was established May 2, 1904. It is located about 2 miles southeast of Trull post-office, on the stage road between Steamboat Springs and Hayden, Colo., in sec. 32, T. 7 N., R. 85 W., and is below all tributaries.

The channel is straight for 100 feet above and for 300 feet below the station. Both banks are low but are not liable to overflow except at very high stages. The bed of the stream is composed of rock and is permanent. There is but one channel at all stages. The

current is swift at all times and exceedingly so at high water. Ice conditions render gage readings impracticable during the winter months. Gage heights have an ordinary range of about 4 feet.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. The initial point for soundings is the vertical wall of the masonry abutment at the left end of the bridge on the downstream side. There is also a stay-wire about 50 feet above the bridge for holding the meter at high stages.

The gage was read twice each day during 1905 by H. W. Hitchins. The original gage was timber, placed vertically near the right end of the bridge. This was replaced June 22, 1904, by a standard chain gage, referred to the same datum. The chain hangs from a point 25 feet from the initial point for soundings on the downstream side of the bridge. The length of the chain is 16.20 feet. The bench mark is a United States Geological Survey standard aluminum bench-mark tablet, set on the downstream end of the masonry abutment at the right end of the bridge; elevation, 15.995 feet above datum of gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 78-80.

Discharge measurements of Elk River near Trull, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 7	H. G. Graham	115	315	2.95	7.28	931
June 11	Hinderlider and Graham	115	449	6.01	8.78	2,6[illegible]
July 25	H. G. Graham	95	125	2.31	6.00	2[illegible]
August 26	do	86	47	2.30	5.20	1[illegible]

Daily gage height, in feet, of Elk River near Trull, Colo., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	.....	8.9	7.72	6.0	5.1	17	8.15	8.65	6.52	5.3	.....
2	.....	8.95	7.8	5.85	5.1	18	8.5	8.55	6.38	5.3	.....
3	.....	9.08	8.52	5.78	5.1	19	8.75	8.3	6.38	5.28	.....
4	.....	9.5	7.85	5.72	5.1	20	8.8	8.28	6.42	5.25	.....
5	.....	9.55	7.25	5.7	5.2	21	8.9	8.4	6.3	5.2	.....
6	.....	9.1	7.15	5.65	5.25	22	9.02	8.35	6.28	5.18	.....
7	7.25	9.05	7.2	5.65	5.32	23	9.22	8.45	6.32	5.15	.....
8	7.4	9.25	7.25	5.62	5.32	24	9.15	8.52	6.15	5.15	.....
9	7.9	9.42	6.95	5.6	5.22	25	8.85	8.45	6.0	5.2	.....
10	7.8	9.0	6.9	5.6	.....	26	8.78	8.2	5.95	5.2	.....
11	7.5	8.78	6.85	5.65	.....	27	8.8	8.05	5.9	5.2	.....
12	7.4	8.88	6.85	5.65	.....	28	8.72	8.15	5.9	5.18	.....
13	7.45	8.85	6.82	5.55	.....	29	8.45	8.0	5.82	5.15	.....
14	7.45	8.88	6.7	5.52	.....	30	8.3	8.1	5.88	5.18	.....
15	7.4	8.9	6.78	5.42	.....	31	8.55	.....	5.88	5.15	.....
16	7.85	8.85	6.65	5.38	.....						

Station rating table for Elk River near Trull, Colo., from May 2, 1904, to September 9, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.00	60	6.00	312	7.00	785	8.00	1,520
5.10	73	6.10	350	7.10	845	8.20	1,710
5.20	88	6.20	390	7.20	905	8.40	1,910
5.30	107	6.30	430	7.30	975	8.60	2,120
5.40	130	6.40	470	7.40	1,045	8.80	2,365
5.50	156	6.50	520	7.50	1,115	9.00	2,630
5.60	184	6.60	570	7.60	1,190	9.20	2,910
5.70	213	6.70	620	7.70	1,270	9.40	3,190
5.80	244	6.80	670	7.80	1,350	9.60	3,485
5.90	277	6.90	725	7.90	1,430		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is fairly well defined between gage heights 5.5 feet and 9 feet.

Estimated monthly discharge of Elk River near Trull, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 7-31	2,938	940	1,841	91,290
June	3,410	1,520	2,303	137,000
July	2,032	250	667	41,010
August	312	80	146	8,977
September 1-9	111	73	87.9	1,569
The period				279,800

FORTIFICATION CREEK AT CRAIG, COLO.

Fortification Creek rises near Mount Walba, in northeastern Routt County, Colo., flows westward, southeastward, and southwestward, and joins Yampa River at Craig.

The gaging station was established June 12, 1905. It is located at the highway bridge about one-fourth mile east of Craig, Colo., in sec. 6, T. 6 N., R. 90 W.

The channel is straight for about 50 feet above and 20 feet below the station. The right bank is low and overflows at very high water; the left bank is high. The bed of the stream is composed of sand and silt and is shifting. There is at all stages but one channel, which is dry late in the summer.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is fastened. The initial point for soundings is the lower side of the bridge, flush with the west abutment.

The gage, which was read twice each day by H. W. Rose, a civil engineer who lives at the station, is a vertical staff, fastened to the east abutment on the lower side of the bridge.

A measurement made June 12, 1905, by H. G. Graham, gave the following results: Width, 51 feet area, 84 square feet; mean velocity, 2.52 feet per second; gage height, 4.40 feet; discharge, 212 second-feet.

Daily gage height, in feet, of Fortification Creek at Craig, Colo., for 1905.

Day.	June.	Day.	June	Day.	June.	Day.	June.
1	5.55	7	5.1	13	4.15	19	3.2
2	5.92	8	5.05	14	3.95	20	2.95
3	5.88	9	5.05	15	3.75	21	2.85
4	6.2	10	5.45	16	3.7	22	2.75
5	6.4	11	4.7	17	3.5	23	2.7
6	6.1	12	4.6	18	3.35	24	2.7

NOTE.—Creek dry after June 24.

WILLIAMS RIVER AT HAMILTON, COLO.

Williams River rises in the White River Plateau, the highest portion of which reaches an elevation of 11,000 feet. It flows northwestward and unites with Yampa River about 7 miles below Craig. It is joined by numerous small tributaries which drain portions of the Williams River Mountains on the east and the Danforth Hills on the south. The largest of these tributaries is Marapos Creek, which rises near the Milk Creek divide, flows eastward, and joins Williams River at Hamilton. The entire drainage area is hilly or mountainous, and throughout the upper portion of it there are extensive forests, mainly of white pine and spruce. Farther down the forests give way to a growth of willows and cottonwood along the river bottom and oak brush and shrubbery on the hillsides. Agriculture is confined to the narrow valley extending along the river and some of its largest tributaries. Wild hay is the principal crop, and cattle raising is carried on extensively. The precipitation consists chiefly of snow during the winter months. The maximum discharge occurs during the latter part of May.

The gaging station was established April 29, 1904. It is located at the highway bridge at Hamilton, on the stage road from Meeker to Craig, Colo., about 17 miles from Craig, in sec. 20, T. 5 N., R. 91 W.

The channel is straight for about 150 feet above and 100 feet below the station. The right bank is high, rocky, and clean; the left bank is low and wooded, but does not overflow except at extreme high stages. The bed of the stream is composed of cobblestones and gravel, but is shifting. There is but one channel at all stages. Gage heights have an ordinary range of about 3 feet. During the winter season ice obstructs the channel to such an extent that gage readings are impracticable.

Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is the downstream end of the vertical log abutment at the left end of the bridge.

The gage, which during the early part of 1905 was read twice each day by Mrs. Thomas Hamilton, was a 14-foot timber, driven vertically into the bottom of the river, with the upper end fastened to the lower side of the bridge. May 21, 1905, a standard chain gage was installed, the datum being the same as that of the original gage. The length of the chain is 14.94 feet. The gage is referred to bench marks as follows: (1) A nail driven into the top log at the northeast corner of the left abutment of the bridge; elevation, 12.22 feet. (2) The head of a nail driven into a root on the west side of a small cottonwood tree about 25 feet from the left end of the bridge and just east of the road; elevation, 10.08 feet. (3) A nail driven into the southeast corner of the foundation of the blacksmith shop about 25 feet from the left end of the bridge; elevation, 10.08 feet. (4) A United States Geological Survey standard iron post at the southeast corner of the wagon bridge; elevation, 10.77 feet. Elevations are above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 80–82.

Discharge measurements of Williams River at Hamilton, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 3	H. G. Graham	46	149	2.87	4.10	428
May 21	do	60	262	4.91	6.05	1,286
June 7	Hinderlider, Hoyt, and Graham	55	199	4.22	5.48	840
June 13	H. G. Graham	55	203	4.98	5.55	1,011
July 23	do	39	76	1.17	3.25	89
Do	do	39	80	1.10	3.30	88
August 28	do	38	64	.55	2.90	35

Daily gage height, in feet, of Williams River at Hamilton, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.78	4.25	5.95	3.8	3.48	2.78	3.02
2	2.8	4.55	6.02	3.85	3.25	2.8	2.95
3	2.8	4.15	6.05	3.82	3.2	2.82	2.95
4	2.78	3.78	6.5	3.75	3.12	2.85	2.92
5	2.75	3.7	6.4	3.62	3.0	2.88	2.9
6	2.78	3.6	5.82	3.65	3.08	3.05	2.9
7	2.78	3.52	5.75	3.6	3.0	3.08	2.88
8	2.88	3.8	5.82	3.55	3.0	3.0	3.35
9	2.95	4.4	6.15	3.5	2.98	2.98	2.9
10	2.95	4.32	5.72	3.4	2.92	2.88	2.95
11	2.92	4.1	5.32	3.6	3.0	2.88	2.85
12	2.95	4.0	5.3	3.3	3.1	2.85	2.9
13	2.9	4.08	5.4	3.35	3.15	2.82	2.98
14	2.92	3.95	5.35	3.3	3.05	2.9	2.92
15	2.92	3.95	5.40	3.25	2.98	2.85	2.95
16	2.95	4.3	5.40	3.12	2.92	2.82	2.95
17	3.0	4.9	4.85	3.18	2.8	2.78	2.98
18	3.0	5.32	4.95	3.2	2.82	2.85	2.92
19	3.1	5.6	4.78	3.2	2.88	2.88	2.85
20	3.15	5.95	4.60	3.45	2.9	2.85	2.85
21	3.1	5.92	4.65	3.58	2.88	2.92	2.88
22	3.02	6.28	4.65	3.38	2.82	2.92	2.9
23	3.05	6.65	4.78	3.28	2.82	2.85	3.0
24	3.1	6.62	4.65	3.18	2.85	2.88	3.05
25	3.18	5.9	4.4	3.05	2.9	2.88	3.0
26	3.18	5.82	4.3	3.05	2.95	3.0	2.98
27	3.28	6.0	4.18	3.05	2.9	2.98	3.0
28	3.6	5.6	4.08	3.5	2.85	2.92	2.98
29	3.65	5.22	4.05	3.2	2.85	2.98	2.98
30	3.82	5.28	3.92	3.12	2.8	3.05	3.0
31	.....	5.65	.....	3.15	2.78	.....	3.0

Station rating table for Williams River at Hamilton, Colo., from April 1 to May 23, 1905

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	60	3.80	330	4.90	720	6.00	1,240
2.80	80	3.90	360	5.00	760	6.10	1,300
2.90	100	4.00	390	5.10	800	6.20	1,360
3.00	125	4.10	420	5.20	845	6.30	1,430
3.10	150	4.20	455	5.30	890	6.40	1,500
3.20	175	4.30	490	5.40	935	6.50	1,570
3.30	200	4.40	525	5.50	980	6.60	1,640
3.40	225	4.50	560	5.60	1,030	6.70	1,710
3.50	250	4.60	600	5.70	1,080		
3.60	275	4.70	640	5.80	1,130		
3.70	300	4.80	680	5.90	1,180		

NOTE.—The above table is applicable only for open-channel conditions. It is based on two discharge measurements made during 1905. It is not well defined.

Station rating table for Williams River at Hamilton, Colo., from May 24 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	15	3.80	200	4.90	565	6.00	1,160
2.80	25	3.90	225	5.00	605	6.10	1,230
2.90	35	4.00	255	5.10	650	6.20	1,310
3.00	50	4.10	285	5.20	700	6.30	1,390
3.10	65	4.20	315	5.30	750	6.40	1,470
3.20	80	4.30	345	5.40	800	6.50	1,550
3.30	95	4.40	375	5.50	850	6.60	1,630
3.40	110	4.50	410	5.60	910	6.70	1,710
3.50	130	4.60	445	5.70	970		
3.60	150	4.70	485	5.80	1,030		
3.70	175	4.80	525	5.90	1,090		

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. It is well defined between gage heights 2.9 feet and 3.3 feet.

Estimated monthly discharge of Williams River at Hamilton, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	336	70	135	8,033
May	1,675	255	737	45,330
June	1,550	231	745	44,3[illegible]
July	212	58	115	7,071
August	126	23	46.6	2,865
September	62	23	36.6	2,17[illegible]
October	102	30	43.6	2,681
The period				112,50[illegible]

MILK CREEK NEAR AXIAL, COLO.

Milk Creek rises in the northeastern part of Rio Blanco County, Colo., flows northwestward, and enters Yampa River about 20 miles below Craig.

The gaging station was established April 20, 1904. It is located at the highway bridge about 4 miles below Axial, Colo., in sec. 19, T. 4 N., R. 92 W.

The channel is straight for 75 feet above and 50 feet below the station. Both banks are high and clean and do not overflow. The bed of the stream is composed of sand, and shifts to such an extent that it is difficult to obtain a good rating curve. There is but one channel at all stages, the current being swift at high and medium at low water. Gage heights have a range of about 3.5 feet during an ordinary season. Ice conditions render gage readings impracticable during the winter months.

Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is at the left end of the bridge, at the water's edge, on the downstream side.

The original gage, which was read once each day during 1905 by Mrs. O. M. Hoback, who lives three-fourths of a mile east of the station, is a vertical staff, 10 feet long, driven 2 feet into the sandy bed of the stream, the top being nailed to the bridge timbers. The gage is referred to bench marks as follows: (1) A nail driven about 4 inches above the ground into the east side of a telephone pole 25 feet south of the bridge; elevation, 10.96 feet. (2) A nail driven into the north side of a 12-inch pile at the northeast corner of the bridge; elevation 10.08 feet. (3) A United States Geological Survey standard iron bench-mark post, set July 21, 1904, about 50 feet southeast of the gage rod; elevation 12.33 feet. Elevations are above the zero of the gage.

This station has been discontinued.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 83–85.

Discharge measurements of Milk Creek near Axial, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 2	H. G. Graham	25	77	2.23	5.80	172
May 20	do	30	128	1.90	6.80	242
June 13	do	22	39	1.75	4.85	68
July 22	do	15	8.7	.31	3.45	2.7
Aug. 28	do	16	10	.37	3.50	3.7

Daily gage height, in feet, of Milk Creek near Axial, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	3.6	5.5	6.45	3.45	3.7	17	3.8	6.1	4.35	3.4	.....
2	3.55	5.8	6.4	3.5	3.6	18	3.8	6.5	4.25	3.4	.....
3	3.55	5.5	6.3	3.5	3.6	19	4.0	6.9	4.1	3.5	.....
4	3.5	5.3	6.35	3.5	3.6	20	4.0	6.8	4.1	3.6	.....
5	3.5	4.85	6.2	3.5	3.6	21	3.9	7.1	4.0	3.5	.....
6	3.5	4.9	5.8	3.45	3.6	22	3.8	6.95	3.85	3.45	.....
7	3.55	4.8	5.6	3.5	3.5	23	3.85	7.1	3.8	3.5	.....
8	3.6	4.95	5.5	3.45	3.5	24	3.9	7.15	3.7	3.45	.....
9	3.65	5.7	5.4	3.45	3.5	25	4.0	6.85	3.65	3.4	.....
10	3.75	5.8	5.15	3.5	3.5	26	4.1	6.8	3.5	3.4	.....
11	3.75	5.4	4.7	3.6	3.6	27	4.2	6.8	3.5	3.4	.....
12	3.8	5.35	4.9	3.4	3.6	28	4.8	6.55	3.5	3.5	.....
13	3.9	5.25	4.8	3.5	3.5	29	4.95	6.3	3.5	3.45	.....
14	3.8	5.3	4.6	3.5	3.5	30	5.15	6.2	3.5	3.5	.....
15	3.8	5.3	4.4	3.5	3.5	31	.....	6.4	.....	3.4	.....
16	3.8	5.65	4.4	3.4	3.5						

Station rating table for Milk Creek near Axial, Colo., from April 20, 1904, to May 17, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	2	4.10	48	5.00	111	5.80	175
3.30	4	4.20	55	5.10	119	5.90	183
3.40	8	4.30	62	5.20	127	6.00	191
3.50	12	4.40	69	5.30	135	6.10	200
3.60	17	4.50	76	5.40	143	6.20	209
3.70	23	4.60	83	5.50	151	6.30	218
3.80	29	4.70	90	5.60	159	6.40	227
3.90	35	4.80	97	5.70	167	6.50	236
4.00	41	4.90	104				

NOTE.—The above table is applicable only for open channel conditions. It is based on five discharge measurements made during 1904, and it is fairly well defined.

Station rating table for Milk Creek near Axial, Colo., from May 18 to August 16, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	2	4.40	41	5.40	111	6.40	201
3.50	4	4.50	46	5.50	119	6.50	211
3.60	7	4.60	52	5.60	128	6.60	221
3.70	10	4.70	58	5.70	137	6.70	231
3.80	13	4.80	65	5.80	146	6.80	241
3.90	17	4.90	72	5.90	155	6.90	251
4.00	21	5.00	79	6.00	164	7.00	261
4.10	26	5.10	87	6.10	173	7.10	271
4.20	31	5.20	95	6.20	182	7.20	281
4.30	36	5.30	103	6.30	191		

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905, and it is fairly well defined.

Estimated monthly discharge of Milk Creek near Axial, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	123	12	35.9	2,136
May	276	97	184	11,310
June	206	4	70.4	4,189
July	7	2	3.5	215
August 1-16	10	4	5.7	181
The period				18,030

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Yampa River basin in 1905:

Miscellaneous discharge measurements made in Yampa River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 26	Little Snake	Maybell, Colo	105	918	5.50	.....	5,050
June 24	do	do	99	430	3.45	3.50	1,483

WHITE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

White River rises in Trappers Lake, which lies at an elevation of 9,500 feet above sea level in a small mountain basin of the White River Plateau in eastern Garfield County, Colo.; thence it flows westward to its point of junction with Green River in west-central Uinta County, Utah. Throughout its course it occupies a narrow, mountainous valley, with alternating parks and canyons, entering the longest and deepest of the canyons, in which it continues to its mouth, about 8 miles east of the Colorado-Utah State line.

The basin comprises an arid, broken, and much eroded plateau region, which topographically is a continuation of the Grand River Mesa south of Grand River. The headwater portion covers the greater area and is called the White River Plateau; below this and to the south is the Roan or Book Cliffs Plateau. Fragmentary plateaus also occur along the northern side of the river.

Numerous small streams, among which are Marvine Creek and South Fork, join the White in the upper, mountainous portion of the basin. Douglas, Piceance, and Evacuation Creeks, draining the Book Cliffs Plateau, enter White River from the south. In the spring these creeks carry considerable water, derived mainly from melting snow, but in the summer they are very nearly dry.

The rocks of the basin are largely of sedimentary origin, and west of the Great Hog Back the relief features produced by erosion are characteristic and remarkably uniform. The shales and marls, wherever sufficiently compact, have been made into steep, inaccessible bluffs, and sandstones have become vertical cliffs. The stream channels are deeply cut, and the flood waters carry a large amount of silt. The soils derived from these rocks vary from sandy to adobe texture, have practically no organic ingredients, and are very friable, and wind and water are constantly breaking them up and transporting them lower down in the basin each year.

Short grasses cover the tops of many of the ridges, while juniper and piñon overgrow their sides. Greasewood and sage brush occur extensively over dry valleys and along plateau-like ridges. In the moist valleys willows and cottonwoods grow in dense masses. In the White River Forest Reserve, which extends over the greater portion of the headwaters, and in general at elevations above 7,500 feet, quaking aspens and spruce predominate, while along the plateaus piñon and cedars are more in evidence.

The mean annual precipitation recorded at Meeker is 15.9 inches; farther west and at lower elevations it is undoubtedly much less.

Numerous ditches along the main stream and some of its tributaries divert water for irrigation, which has been practiced in a desultory way for many years. Native hay and kindred products are the chief agricultural staples in the upper part of the area, while grains, grasses, alfalfa, and some fruits are grown in the lower valleys.

NORTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

This station was established July 28, 1903. It is located at the county bridge at Rawson's ranch, below the mouth of Marvine Creek, 7 miles from Buford, the nearest post-office, and 32 miles from Meeker, Colo.

The channel is straight for 200 feet above and 300 feet below the station. Both banks are high and are not liable to overflow. The bed of the stream is rocky and is free from vegetation. There is but one channel at all stages, broken by the two narrow bridge piers. The current is swift.

Discharge measurements are made from the three-span highway bridge to which the gage is attached. The bridge has a total span of 85 feet. The initial point for soundings is the edge of the abutment at the south end of the bridge.

The gage, which is read twice each day by H. N. Rawson, is a timber spiked to the lower side of the first pier from the south end of the bridge. It reads from 1 foot to 9 feet. The gage is referred to bench marks as follows: (1) The top of a bolt on the bridge nearest the gage; elevation, 11.51 feet. (2) A spike in the trunk of a large cottonwood tree at the southeast corner of the bridge; elevation, 7.46 feet. (3) A spike in one of the abutment logs at the end of the upper sill at the southwest corner of the bridge; elevation, 7.88 feet. Elevations are above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp; 99-100, 133, pp 91-92.
Discharge: 100, p 100; 133, p 92.
Discharge, monthly: 100, p 101; 133, p 93.
Gage heights: 100, p 100; 133, p 92.
Rating table: 100, p 100; 133, p 93.

Discharge measurements of North Fork of White River near Buford, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 15	H. G. Graham	86	111	3.03	2.20	336
June 17	do	86	205	5.82	3.30	1,194
July 6	do	88	129	3.16	2.35	408
July 18	do	87	107	2.93	2.15	314
August 12	do	87	102	2.95	2.15	301
September 16	do	86	80	1.90	1.85	152

Daily gage height, in feet, of North Fork of White River near Buford, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.82	2.55	3.4	2.65	2.2	1.9	1.85
2	1.85	2.5	3.4	2.6	2.15	1.9	1.85
3	1.82	2.3	3.6	2.52	2.1	1.9	1.85
4	1.82	2.18	3.8	2.42	2.1	1.9	1.85
5	1.82	2.12	3.8	2.42	2.05	2.0	1.85
6	1.82	2.15	3.7	2.4	2.05	1.98	1.85
7	1.9	2.22	3.85	2.38	2.0	1.95	1.85
8	1.88	2.48	4.0	2.35	2.0	1.9	1.85
9	1.92	2.48	3.9	2.32	2.0	1.9	1.85
10	1.92	2.32	3.6	2.3	1.98	1.9	1.85
11	1.92	2.28	3.5	2.28	2.05	1.9	1.85
12	1.92	2.22	3.55	2.28	2.1	1.9	1.85
13	1.92	2.22	3.62	2.28	2.02	1.9	1.85

Daily gage height, in feet, of North Fork of White River near Buford, Colo., in 1905—Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
14	1.92	2.2	3.68	2.22	2.0	1.9	1.85
15	1.92	2.22	3.7	2.22	2.0	1.9	1.85
16	1.92	2.58	3.55	2.18	1.95	1.85	1.85
17	1.92	2.75	3.45	2.18	1.95	1.85	1.85
18	1.92	2.95	3.4	2.2	1.95	1.9	1.85
19	1.92	3.02	3.32	2.2	1.95	1.85	1.85
20	1.92	3.38	3.3	2.3	1.95	1.85	1.85
21	1.92	3.55	3.25	2.22	1.9	1.85	1.85
22	1.92	3.65	3.2	2.2	1.9	1.85	1.85
23	1.98	3.7	3.2	2.15	1.9	1.85	1.85
24	1.98	3.35	3.2	2.15	1.9	1.85	1.85
25	1.98	3.25	3.15	2.15	1.9	1.92	1.85
26	2.02	3.25	3.2	2.15	1.9	1.92	1.85
27	2.05	3.28	3.0	2.15	1.9	1.85	1.85
28	2.1	3.05	2.85	2.15	1.92	1.85	1.85
29	2.2	2.95	2.78	2.15	1.92	1.85	1.85
30	2.32	3.05	2.72	2.1	1.9	1.9	1.85
31	.....	3.25	.....	2.15	1.92	.....	1.85

Station rating table for North Fork of White River near Buford, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	135	2.40	450	3.00	910	3.60	1,505
1.90	180	2.50	515	3.10	1,000	3.70	1,610
2.00	225	2.60	585	3.20	1,095	3.80	1,720
2.10	275	2.70	660	3.30	1,195	3.90	1,835
2.20	330	2.80	740	3.40	1,295	4.00	1,950
2.30	390	2.90	825	3.50	1,400		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.8 feet and 2.4 feet.

Estimated monthly discharge of North Fork of White River near Buford, Colo., for 1905.

[Drainage area, 181 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	402	144	200	11,900	1.10	1.23
May	1,610	286	756	46,480	4.18	4.82
June	1,950	676	1,332	79,260	7.36	8.21
July	622	275	375	23,060	2.07	2.39
August	330	180	219	13,470	1.21	1.40
September	225	157	176	10,470	.972	1.08
October	157	157	157	9,654	.867	1.00
The period	.....	.....	.....	194,300	.....	.....

SOUTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

This station was established July 25, 1903. It is located at the county bridge at the lower end of a section of the river known as "Stillwater," about 7 miles from Buford, the nearest post-office, and about 30 miles from Meeker, Colo., in T. 1 S., R. 91 W.

The channel is straight for 50 feet above the station and for 300 feet below. Both banks are high and are covered with grass and sagebrush. The bed of the stream below the "Stillwater" and at the station is covered with bowlders, some of which are 2 or 3 feet in diameter. There is but one channel at all stages, broken by the middle pier of the bridge, and the current is swift. During the winter months ice obstructs the channel to such an extent that gage readings are impracticable.

High-water measurements are made from the bridge, which makes an angle of 20° with the normal to the stream. This is taken into account in making the measurements. The initial point for soundings is the edge of the abutment at the west end of the bridge. At low water, measurements are made by wading.

The gage, which was read twice each day during 1905 by Claud Dobbs, is a 10-foot vertical timber spiked to the upper side of the middle pier. The gage is referred to bench marks as follows: (1) The first bolt on the bridge east of the gage; elevation, 11.95 feet. (2) A spike in one of the logs of the abutment at the southwest corner of the bridge; elevation, 8.57 feet. (3) The corner of a large rock 30 feet west of the bridge and north of the road; elevation, 13.14 feet. (4) The top of a pyramid-shaped rock on the east side of the river below the bridge 41 feet distant from the northeast bolt on the bridge tie and projecting 8 inches above the ground; elevation, 7.02 feet. Elevations are above the zero of the gage. The elevation of the station above sea level, as determined by aneroid barometer, is 7,400 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 97-98; 133, p 94.
Discharge: 100, p 98; 133, p 94.
Discharge, monthly: 100, p 99; 133, p 96.
Gage heights: 100, p 98; 133, p 95.
Rating table: 100, p 99; 133, p 96.

Discharge measurements of South Fork of White River near Buford, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 16	H. G. Graham	55	91	2.93	2.80	267
June 19	do	55	251	6.39	5.70	1,603
July 7	do	55	110	3.61	3.15	397
Juy 19	do	55	97	2.96	2.90	287
August 13	do	55	86	3.04	2.70	262
September 19	do	55	72	2.3	2.45	166

Daily gage height, in feet, of South Fork of White River near Buford, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct
1	2.4	2.95	4.88	3.5	2.72	2.45	2.45
2	2.4	3.05	5.18	3.45	2.7	2.45	2.45
3	2.4	2.95	5.48	3.4	2.7	2.45	2.45
4	2.35	2.82	6.22	3.32	2.7	2.5	2.45
5	2.38	2.8	6.9	3.25	2.68	2.58	2.45
6	2.4	2.75	6.52	3.2	2.65	2.55	2.45
7	2.4	2.75	6.55	3.15	2.62	2.55	2.45

Daily gage height, in feet, of South Fork of White River near Buford, Colo., for 1905—Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
8	2.42	2.75	6.68	3.12	2.6	2.55	2.45
9	2.45	2.85	7.4	3.05	2.6	2.5	2.45
10	2.48	2.85	6.85	3.05	2.6	2.5	2.42
11	2.48	2.85	6.28	3.02	2.7	2.48	2.45
12	2.5	2.78	6.25	2.98	2.7	2.45	2.45
13	2.5	2.8	6.5	2.95	2.68	2.45	2.45
14	2.5	2.78	6.12	2.92	2.6	2.45	2.45
15	2.5	2.75	6.42	2.9	2.6	2.45	2.45
16	2.5	2.85	6.75	2.88	2.6	2.45	2.45
17	2.5	3.0	5.75	2.85	2.55	2.45	2.45
18	2.5	3.18	5.6	2.85	2.55	2.45	2.45
19	2.55	3.4	5.2	2.88	2.55	2.45	2.4
20	2.55	3.55	5.0	2.92	2.52	2.45	2.32
21	2.5	3.65	4.7	2.88	2.5	2.45	2.38
22	2.5	3.92	4.8	2.82	2.5	2.45	2.42
23	2.5	4.35	4.95	2.8	2.5	2.45	2.45
24	2.5	4.45	5.05	2.78	2.5	2.45	2.45
25	2.55	4.22	4.5	2.75	2.5	2.45	2.45
26	2.55	4.38	4.45	2.75	2.5	2.45	2.45
27	2.6	4.45	4.15	2.75	2.5	2.45	2.45
28	2.65	4.45	3.92	2.72	2.48	2.45	2.45
29	2.7	4.22	3.7	2.7	2.5	2.45	2.45
30	2.8	4.22	3.6	2.7	2.48	2.52	2.45
31	.....	4.55	.....	2.7	2.48	.....	2.45

Station rating table for South Fork of White River near Buford, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	115	3.50	510	4.70	1,050	5.90	1,725
2.40	145	3.60	550	4.80	1,100	6.00	1,790
2.50	175	3.70	590	4.90	1,150	6.20	1,920
2.60	205	3.80	630	5.00	1,200	6.40	2,060
2.70	235	3.90	675	5.10	1,255	6.60	2,200
2.80	265	4.00	720	5.20	1,310	6.80	2,350
2.90	300	4.10	765	5.30	1,365	7.00	2,500
3.00	335	4.20	810	5.40	1,420	7.20	2,660
3.10	370	4.30	855	5.50	1,480	7.40	2,820
3.20	405	4.40	900	5.60	1,540		
3.30	440	4.50	950	5.70	1,600		
3.40	470	4.60	1,000	5.80	1,660		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 2.4 feet and 5.7 feet.

Estimated monthly discharge of South Fork of White River near Buford, Colo., for 1905.

[Drainage area, 148 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	265	130	175	10,410	1.18	1.32
May	975	250	497	30,560	3.36	3.87
June	2,820	550	1,569	93,360	10.60	11.83
July	510	235	324	19,920	2.19	2.52
August	241	169	200	12,300	1.35	1.56
September	199	160	167	9,937	1.13	1.26
October	160	121	157	9,654	1.06	1.22
The period				186,100		

WHITE RIVER AT MEEKER, COLO.

This station was established May 24, 1901. It is located about one-half mile above the town of Meeker, at a point where a wagon bridge crosses the stream, on the ranch of L. F. Van Cleave, in sec. 25, T. 1 N., R. 94 W.

The channel is straight for 500 feet above and below the station. Both banks are high and not liable to overflow. The bed of the stream is composed of gravel and cobblestones and seems to be permanent. There is but one channel at all stages. The current is always swift and is extremely so at high water. Gage heights have an ordinary range of about 2.5 feet. During the winter months ice obstructs the channel to such an extent that gage readings are impracticable.

Discharge measurements are made from either the upstream or downstream side of the bridge, the initial point being at the left end.

The gage, which was read twice each day during 1905 by L. F. Van Cleave, consists of a vertical timber nailed to the left abutment of the bridge on the downstream side. The gage is referred to bench marks as follows: (1) The top of a bolt in the truss immediately above the gage rod; elevation, 10.83 feet above the zero of the gage. (2) A standard United States Geological Survey iron post, located 30 feet north of the north end of the bridge; elevation, 8.807 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 66, pp 91-92; 85, p 50; 100, pp 95-96; 133, p 97.
Discharge: WS 50, p 375; 66, p 92; 85, p 51; 100, p 96; 133, p 97.
Discharge, low-water: Ann 22, iv, p 396.
Discharge, monthly: WS 85, p 52; 100, p 97; 133, p 99.
Gage heights: WS 28, p 143; 66, p 92; 85, p 51; 100, p 96; 133, p 98.
Rating tables: WS 85, p 51; 100, p 97; 133, p 98.

Discharge measurements of White River at Meeker, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 25	Stiles and Hinderlider	79	166	1.80	3.60	299
April 3	A. J. Stiles	79	166	2.40	3.60	398
April 29	H. G. Graham	79	233	3.77	4.20	879
May 1	do	79	271	3.89	4.72	1,052
May 18	do	79	316	5.04	5.20	1,593
May 19	do	79	332	5.42	5.40	1,801
June 5	do	79	403	8.77	6.40	3,536
June 20	do	78	332	6.40	5.60	2,126
June 30	do	78	281	4.06	4.90	1,141
July 14	do	78	207	2.99	4.00	620
July 15	do	78	203	2.48	3.95	505
August 5	do	78	184	2.28	3.72	419
August 7	do	78	191	2.25	3.80	429

Daily gage height, in feet, of White River at Meeker, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.6	4.65	5.95	4.72	3.9	3.6	3.7
2	3.62	4.85	5.98	4.65	3.85	3.6	3.7
3	3.6	4.58	6.0	4.6	3.85	3.6	3.65
4	3.6	4.4	6.15	4.48	3.75	3.62	3.65
5	3.6	4.3	6.32	4.38	3.7	3.75	3.65
6	3.6	4.25	6.25	4.35	3.7	3.75	3.6
7	3.65	4.2	6.18	4.3	3.68	3.78	3.6
8	3.7	4.35	6.18	4.25	3.65	3.7	3.6
9	3.72	4.75	6.3	4.2	3.65	3.65	3.6
10	3.75	4.55	6.25	4.12	3.65	3.65	3.6
11	3.78	4.48	6.05	4.1	3.9	3.62	3.6
12	3.78	4.4	6.0	4.02	3.98	3.6	3.6
13	3.8	4.42	6.05	4.0	3.88	3.6	3.6
14	3.8	4.38	5.95	3.98	3.82	3.6	3.6
15	3.72	4.35	6.0	3.95	3.75	3.55	3.6
16	3.72	4.58	6.1	3.9	3.75	3.55	3.6
17	3.72	4.95	5.9	3.88	3.7	3.55	3.62
18	3.72	5.15	5.8	3.85	3.65	3.65	3.65
19	3.85	5.4	5.65	3.85	3.65	3.65	3.6
20	3.85	5.55	5.52	4.0	3.65	3.65	3.55
21	3.82	5.58	5.48	3.98	3.65	3.6	3.62
22	3.8	5.82	5.52	3.9	3.65	3.58	3.62
23	3.8	5.98	5.52	3.85	3.58	3.55	3.7
24	3.82	6.02	5.52	3.82	3.55	3.58	3.65
25	3.88	5.85	5.45	3.8	3.6	3.68	3.62
26	3.88	5.82	5.35	3.8	3.58	3.68	3.62
27	4.02	5.9	5.25	3.78	3.55	3.6	3.62
28	4.12	5.85	5.1	3.72	3.62	3.6	3.62
29	4.18	5.65	4.95	3.75	3.65	3.68	3.62
30	4.32	5.62	4.8	3.75	3.62	3.8	3.6
31	.....	5.68	.....	3.82	3.6	.....	3.6

Station rating table for White River at Meeker, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.50	345	4.30	700	5.10	1,420	5.90	2,580
3.60	370	4.40	760	5.20	1,540	6.00	2,760
3.70	400	4.50	835	5.30	1,670	6.10	2,950
3.80	435	4.60	910	5.40	1,800	6.20	3,140
3.90	480	4.70	1,000	5.50	1,940	6.30	3,330
4.00	530	4.80	1,090	5.60	2,080	6.40	3,530
4.10	580	4.90	1,190	5.70	2,240		
4.20	640	5.00	1,300	5.80	2,410		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5, and is fairly well defined.

Estimated monthly discharge of White River at Meeker, Colo., for 1905.

[Drainage-area, 634 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	712	370	443	26,360	0.699	0.780
May	2,798	640	1,490	91,620	2.35	2.71
June	3,370	1,090	2,444	145,400	3.85	4.30
July	1,018	407	572	35,170	.902	1.04
August	520	357	405	24,900	.639	.737
September	435	357	382	22,730	.603	.673
October	400	357	376	23,120	.593	.684
The period				369,300		

WHITE RIVER NEAR RANGELY, COLO.

This station was established April 14, 1904. It is located at the wagon bridge 1 mile west of Rangely, Colo., in sec. 3, T. 2 N., R. 102 W.

The channel is curved at the station and the bridge makes an angle of 15° with the radius of the curve. The right bank is high and clean and does not overflow; the left bank is low and clean, and overflows at high stages. The bed of the stream is composed of sand and gravel and is shifting. There is but one channel at all stages. There is an island about 200 feet above the bridge which breaks the current and causes it to run diagonally across the channel in various directions. The current is swift at all times and at high stages surges rapidly. Conditions at this station are unfavorable for accurate measurements, but there is no other available point on this section of the stream.

Discharge measurements are made from the downstream side of the single-span bridge, to which the gage is attached. The initial point for soundings is the vertical wall of the right abutment.

The gage, which was read twice each day during 1905 by Miss Zinnia Coltharp, is a 12-foot timber fastened to the downstream side of the right abutment of the bridge. The bench mark is a United States Geological Survey standard aluminum tablet, set on the top stone of the right abutment on the downstream side of the bridge; elevation, 16.86 feet above the zero of the gage.

This station was abandoned December 31, 1905.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 99-101.

Discharge measurements of White River near Rangely, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 30	A. J. Stiles	79	208	2.53	3.70	526
June 2	H. G. Graham	90	515	6.48	5.90	3,336
June 3	do	90	521	6.63	6.00	3,457
July 11	do	78	239	2.51	3.95	600
August 3	do	77	238	2.46	3.90	587
September 5	do	77	260	3.07	4.20	798

Daily gage height, in feet, of White River near Rangely, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.78	4.25	5.62	4.8	3.94	3.75	4.88
2	3.68	4.5	5.85	4.8	3.92	3.78	4.82
3	3.79	4.5	5.98	4.78	3.9	3.8	4.38
4	3.81	4.3	6.0	4.75	3.9	3.82	4.18
5	3.72	4.2	6.0	4.75	3.9	4.15	4.05
6	3.66	4.1	6.22	4.58	3.88	4.18	3.92
7	3.69	4.0	6.38	4.45	3.9	4.14	3.78
8	3.78	4.0	6.22	4.18	3.9	4.1	3.7
9	3.82	4.1	6.3	4.14	3.88	4.1	3.72
10	3.9	4.42	6.32	4.14	3.86	3.98	3.78
11	3.9	4.35	6.45	4.1	3.89	3.99	3.85
12	3.88	4.26	6.55	3.96	3.9	3.96	3.89
13	3.88	4.22	6.38	3.89	3.9	3.95	3.9
14	3.88	4.2	6.12	3.84	3.88	3.8	3.89
15	3.81	4.22	6.15	3.82	3.9	3.8	3.89
16	3.81	4.24	6.0	3.79	3.89	3.85	3.9
17	3.74	4.28	6.11	3.82	3.88	3.8	3.9
18	3.75	4.5	6.15	3.84	3.89	3.85	3.88
19	3.76	4.78	5.85	3.82	3.9	3.85	3.88
20	3.78	4.6	5.5	3.84	3.89	3.9	3.9
21	3.82	5.15	5.36	3.82	3.86	3.85	3.9
22	3.81	5.84	5.29	3.86	3.85	3.82	3.9
23	3.81	5.92	5.22	3.89	3.89	3.92	3.9
24	3.8	6.0	5.32	3.9	3.92	3.88	3.88
25	3.81	6.16	5.26	3.81	3.91	3.85	3.88
26	3.83	6.28	5.19	3.85	3.92	3.9	3.9
27	3.85	5.95	5.08	3.88	3.95	3.92	3.91
28	3.88	5.92	4.99	3.89	3.95	4.75	3.92
29	3.92	5.98	4.95	3.89	3.88	4.92	3.9
30	4.0	5.92	4.92	3.9	3.85	4.98	3.9
31	.....	5.5	.....	3.9	3.81	.....	3.9

Station rating table for White River near Rangely, Colo., from April 1 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	380	4.40	1,010	5.20	2,020	6.00	3,490
3.70	435	4.50	1,110	5.30	2,180	6.10	3,710
3.80	495	4.60	1,220	5.40	2,350	6.20	3,930
3.90	565	4.70	1,330	5.50	2,520	6.30	4,160
4.00	645	4.80	1,450	5.60	2,700	6.40	4,390
4.10	730	4.90	1,580	5.70	2,890	6.50	4,630
4.20	820	5.00	1,720	5.80	3,080	6.60	4,870
4.30	910	5.10	1,870	5.90	3,280		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905 and is not well defined.

Estimated monthly discharge of White River near Rangely, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	645	413	506	30,1[illegible]
May	4,114	645	1,752	107,7[illegible]
June	4,750	1,608	3,152	187,[illegible]
July	1,450	489	748	45,[illegible]
August	605	502	561	34,[illegible]
September	1,692	381	674	40,[illegible]
October	1,554	435	636	39,[illegible]
The period				485,[illegible]

MARVINE CREEK NEAR BUFORD, COLO.

Marvine Creek rises in Marvine Lake, in the southeastern part of Rio Blanco County, Colo., and flows northwestward to its point of junction with White River.

The gaging station was established July 27, 1903. It is located at a point where the stream is crossed by a large aspen log. The station is 10 miles from Buford, the nearest post-office, and is about 35 miles from Meeker.

The channel is 30 feet wide and is straight for 100 feet above and below the station. The right bank is sloping and will overflow for 10 or 15 feet at high water. The left bank is steep and is not liable to overflow. Both banks are covered with thick brush. The bed of the stream is covered with bowlders and is free from vegetation. The channel is divided into two parts by a large sunken log, which supports the middle of the footbridge. The current is swift.

Discharge measurements are made from the log which spans the stream at the gage. The initial point for soundings is at the gage rod.

The gage, which is read twice daily by James Fitzgerald, is a vertical 5-foot timber fastened to the lower side of the foot log, which is used as a bridge. It is referred to bench marks as follows: (1) The top of a rock 22 feet west of the gage rod; elevation, 4.62 feet. (2) The top of a triangular-shaped rock between two spruce trees on the west bank; elevation, 6.01 feet. (3) The top of a large rock 30 feet northwest of the gage; elevation, 4.61 feet. Elevations are above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 101; 133, p 103.
Discharge: 100, p 102; 133, p 103.
Discharge, monthly: 100, p 102; 133, p 105.
Gage heights: 100, p 102; 133, p 104.
Rating table: 100, p 102; 133, p 104.

Discharge measurements of Marvine Creek near Buford, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 15	H. G. Graham	29	35	2.54	1.80	90
June 17	do	40	95	7.61	3.50	723
July 6	do	29	41	3.66	2.10	150
July 18	do	29	41	3.56	2.10	146
August 12	do	29	38	3.79	2.00	144
September 18	do	29	37	3.14	1.95	116

Daily gage height, in feet, of Marvine Creek near Buford, Colo., for 1905.

Day	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1.85	2.28	2.32	2.08	1.88	1.95
2	.....	1.85	2.28	2.28	2.02	1.88	1.95
3	.....	1.85	2.3	2.25	2.02	1.88	1.92
4	.....	1.85	2.45	2.22	2.0	1.88	1.92
5	.....	1.85	2.52	2.2	2.0	1.95	1.9
6	.....	1.85	2.45	2.2	2.0	1.95	1.9
7	.....	1.85	2.5	2.15	1.98	1.95	1.9
8	.....	1.85	2.68	2.15	1.98	1.92	1.9
9	.....	1.85	2.78	2.15	1.98	1.92	1.9
10	1.7	1.85	2.7	2.15	2.0	1.92	1.9
11	1.7	1.85	2.6	2.1	2.05	1.92	1.9
12	1.7	1.85	2.6	2.08	2.0	1.9	1.9
13	1.7	1.85	2.7	2.08	1.98	1.9	1.9
14	1.7	1.85	2.7	2.08	1.95	1.9	1.95
15	1.7	1.85	2.8	2.08	1.98	1.9	1.9
16	1.7	1.9	2.7	2.05	1.98	1.9	1.9
17	1.7	1.92	2.65	2.05	1.98	1.9	1.9
18	1.7	1.98	2.6	2.1	1.98	1.9	1.9
19	1.7	2.02	2.55	2.12	1.98	1.9	1.9
20	1.7	2.08	2.52	2.15	1.95	1.9	1.9
21	1.7	2.12	2.5	2.1	1.92	1.9	1.9
22	1.7	2.12	2.55	2.05	1.92	1.9	.....
23	1.75	2.2	2.65	2.05	1.92	1.9	.....
24	1.75	2.15	2.55	2.05	1.92	1.92	.....
25	1.75	2.15	2.45	2.02	1.92	1.92	.....
26	1.75	2.15	2.45	2.02	1.95	1.95	.....
27	1.75	2.18	2.45	2.02	1.95	1.95	.....
28	1.75	2.22	2.38	2.0	1.92	1.95	.....
29	1.85	2.15	2.38	2.0	1.92	1.98	.....
30	1.85	2.15	2.35	2.0	1.92	1.95	.....
31	.....	2.2	.....	2.08	1.92	.....	.....

Station rating table for Marvine Creek near Buford, Colo., from April 10 to October 21, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	74	2.00	126	2.30	205	2.60	304
1.80	89	2.10	150	2.40	235	2.70	339
1.90	106	2.20	177	2.50	269	2.80	377

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.8 feet and 2.1 feet.

Estimated monthly discharge of Marvine Creek near Buford, Colo., for 1905.

[Drainage area, 50 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April 10-30	98	74	78.6	3,274	1.57	1.23
May	183	98	127	7,809	2.54	2.93
June	377	199	272	16,180	5.44	6.07
July	211	126	153	9,408	3.06	3.53
August	145	110	120	7,379	2.40	2.77
September	122	103	109	6,483	2.18	2.43
October 1-21	116	106	108	4,498	2.16	1.69
The period				55,030		

DUCHESNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Duchesne River rises in the high peaks of the Uinta and Wasatch mountains, flows in a general southeasterly direction, and enters Green River 3 miles above the mouth of the White. It is a very crooked stream, swinging back and forth across its valley, its course marked by a thick line of cottonwoods.

The principal tributaries of the Duchesne are Strawberry, East, and Lake creeks and Uinta River. From the mouth of Strawberry Creek down to Lake Creek the valley of the Duchesne averages 2 miles in width and is bordered on both sides by sandstone bluffs approximately 200 feet high. The cliffs on the northern side of the river are capped by a heavy deposit of coarse river gravel and cobblestones.

Strawberry Creek, the main upper tributary of the Duchesne, drains an area of 1,166 square miles. The stream rises in the Uinta Mountains and the run-off is derived chiefly from melting snow except during the late summer, when the flow comes from small springs well distributed over the entire drainage basin. Numerous tributaries enter the stream, particularly from the north and west, Indian, Bryants Fork, Mud, Horse, Sugar Springs, and Co-op creeks being the principal ones. They are all short and fall rapidly until they reach the valley, through which they flow sluggishly in well-defined channels. The main stream traverses the valley from north to south and is very sluggish. Very little sediment is carried by the stream at any stage. The average elevation of Strawberry Valley is 7,500 feet, which is rather high for agricultural purposes but is splendidly adapted to grazing. Indian Creek, on which a gaging station was maintained during 1905, drains a small portion of the southern slopes of the Uinta Mountains. Its basin comprises smooth, rolling hills, fairly well timbered with pine and aspen. The normal flow is derived chiefly from springs.

The greater part of the precipitation is in the form of snow, which covers the ground for six or eight months each year.

Uinta River and its principal tributary, Whiterocks River, have their sources in a series of lakes in the Uinta Mountains, fed by the snow that exists the year round in the canyons and on the high slopes. The upper drainage area of these streams is very mountainous and difficult of access. After leaving their canyons, 7 or 8 miles above the Indian agency at Whiterocks, the rivers flow southeastward, uniting in various channels between the agency and Fort Duchesne, from which point they flow in one channel, entering Duchesne River 6 miles below, near the Ouray Indian school. Pole, Farm, and Dry Gulch creeks are small tributaries of the Uinta.

STRAWBERRY CREEK IN STRAWBERRY VALLEY, UTAH.

This station was established May 2, 1903. It is located in the canyon about one-fourth mile above the junction of Strawberry and Indian creeks, and is somewhat inaccessible, the nearest settlement being Heber, 40 miles away. The chief object of the station is the determination of the amount of water available for storage in Strawberry Valley.

The channel is straight for about 600 feet above and 400 feet below the station. The banks are wooded and are sufficiently high to prevent overflow. The bed of the stream is composed of gravel and during the summer months is overgrown with moss and weeds. The current is sluggish. The stream is frozen during the winter months.

Discharge measurements are made by means of a cable and car of regular form. The initial point for soundings is the first metal tag on the tagged wire at the left bank.

Gage readings and discharge measurements during 1905 were made by T. C. Callister. The original gage was of the vertical type and was used until September, 1904, when a new, inclined gage was established at the same locality, about 1,000 feet above the cable. The datum of the new gage is the same as that of the old. The bench mark is a large sandstone bowlder S. 82° E. 175 feet from the gage, 12 feet from the bank of the river, and projecting about 3 feet above the ground. It is marked "Rec. Ser. B. M. No. 7;" elevation, 19.15 feet above the zero of the gage, and 7,496 feet above sea level. July 2, 1905, a low-water station was established at a riffle about 200 feet below the regular gage, where the velocity is sufficiently high to prevent the growth of vegetation, which interferes seriously with the results at the regular station during the summer months. The gage at this point is a vertical staff driven into the stream bed and is referred to bench mark No. 7, above described, its zero having an elevation of 19.93 feet. The annual discharge at this station is therefore represented by two discharge curves.

Beginning April 15, 1905, evaporation and precipitation observations were made at a point near the station. The evaporation records are obtained by means of a 4 by 4 by 4 foot metallic tank set in the ground with its top about 3 inches from the surface. The equipment used in obtaining the precipitation records is of the standard form used by the United States Weather Bureau stations and was furnished by Doctor Hyatt, director of the Utah division of the United States Weather Bureau. The results of the expermients are shown in the following tables:

Evaporation in Strawberry Valley, Utah.

	Inches.
April	1.43
May	2.37
June	5.68
July	6.03
August	4.71
September	3.20
October	1.31

Precipitation in Strawberry Valley, Utah.

	Inches.
April	1.01
May	1.06
June	.17
July	1.08
August	1.28
September	3.04
October	.78
November	Missing.
December	2.09

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 100, p 112; 133, p. 121.
Discharge: Ann 21, iv, p 322; 22, iv, p 384; WS 50, p 374; 100, p 112, 133, pp 121, 363.
Discharge, monthly: WS 100, p 113; 133, p 122.
Gage heights: WS 100, p 113.
Rating table: WS 100, p 113.

Discharge measurements of Strawberry Creek in Strawberry Valley, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 8 [a]	C. Tanner	28	20	1.01	.....	20
April 17	T. C. Callister	64	75	1.63	1.43	122
April 21	do	64	81	1.72	1.64	140
April 26	do	66	179	2.61	3.15	467
May 1	do	64	125	2.1	2.28	262
May 4	do	64	96	1.83	1.86	176
May 18	do	64	112	2.01	2.12	226
May 23	T. Thomas	68	156	2.36	2.78	368
June 17	T. C. Callister	63	63	1.39	1.20	87
June 25	do	62	53	1.08	.98	57
July 2 [b]	do	37	36	1.23	1.50	44
July 12 [b]	do	37	32	1.11	1.40	35
July 28 [b]	do	37	29	.92	1.31	26
December 8 [a]	A. B. Larson	34	41	.83	1.67	34
December 9 [a]	do	34	45	.83	1.75	37
December 11 [a]	do	34	50	.76	1.85	38
December 13 [a]	do	32	46	.80	1.95	37
December 18 [a]	do	26	46	.73	2.22	34

[a] Creek frozen.
[b] Measurement made at riffle 200 feet below gage. Gage heights refer to temporary gage at riffle.

Daily gage height, in feet, of Strawberry Creek in Strawberry Valley, Utah, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.23	2.35	0.81	1.32	1.27	1.42	.....	1.56
2	.....	2.11	2.34	1.5	1.32	1.3	1.38	1.37	1.58
3	.....	2.06	2.28	1.5	1.32	.....	1.38	.....	1.56
4	.....	1.89	2.24	1.48	1.33	1.3	1.38	1.35	1.56
5	.....	1.74	2.11	1.47	1.32	1.33	1.38	.....	1.54
6	.....	1.66	2.0	1.45	1.3	.....	1.38	1.35	1.51
7	.....	1.64	1.96	1.44	1.29	1.35	1.35	.....	1.6
8	.....	1.68	1.94	1.43	1.27	1.36	.....	1.38	1.67
9	.....	1.76	1.89	1.42	1.27	1.37	1.34	.....	1.75
10	.....	1.76	1.76	1.41	.....	.....	1.33	1.38	1.75

Daily gage height, in feet, of Strawberry Creek in Strawberry Valley, Utah, for 1905—Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	1.67	1.65	1.41	1.33	.....	1.35	.....	1.85
12	.....	1.74	1.56	1.4	1.32	1.31	.....	.....	1.91
13	1.05	1.72	1.48	1.39	1.3	1.31	1.36	1.41	1.95
14	1.23	1.64	1.4	1.39	1.3	.....	1.35	.....	1.99
15	1.3	1.6	1.3	1.48	1.28	.....	.....	.....	2.09
16	1.34	1.7	1.28	1.41	1.27	1.3	1.33	.....	2.12
17	1.42	1.94	1.24	1.38	.....	1.3	1.32	.....	2.15
18	1.42	2.08	1.25	1.36	.....	1.33	.....	.....	2.22
19	1.53	2.2	1.17	1.35	1.25	1.3	1.47	.....	2.23
20	1.47	2.35	1.13	1.37	1.25	1.31	1.45	.....	2.24
21	1.72	2.49	1.09	1.36	1.25	.....	.....	.....	2.27
22	1.84	2.61	1.06	1.38	1.25	1.32	1.43	.....	.....
23	1.88	2.74	1.02	1.37	1.25	1.31	.....	1.43	.....
24	2.24	2.59	1.0	1.35	.....	.....	.....	.....	.....
25	2.88	2.53	.98	1.35	.....	1.45	1.32	1.42	.....
26	2.9	2.6	.95	1.33	.....	1.4	1.32	1.41	.....
27	2.47	2.48	.93	1.3	.....	1.35	1.32	1.48	.....
28	2.38	2.46	.9	1.31	1.3	.....	.....	1.5	.....
29	2.14	2.3	.9	1.31	1.3	1.51	1.35	1.52	.....
30	2.26	2.2	.89	1.31	1.31	1.49	.....	1.58	.....
31	.....	2.26	.....	1.31	1.29	.....	1.38	.....	.....

NOTE.—Gage heights after July 2 refer to new gage at riffle, as the old gage heights were unreliable after that date on account of growing moss.

November 23–26 there was ice along the edges but the flow was unobstructed. November 27–28 back water caused by ice. November 29 to December 31 the creek was frozen completely over. Gage heights are to water surface.

Station rating table for Strawberry Creek in Strawberry Valley, Utah, from April 13 to July 1, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	41	1.40	110	2.00	205	2.60	329
.90	51	1.50	124	2.10	224	2.70	352
1.00	62	1.60	139	2.20	243	2.80	376
1.10	73	1.70	154	2.30	263	2.90	400
1.20	85	1.80	170	2.40	284	3.00	425
1.30	97	1.90	187	2.50	306		

NOTE.—The above table is based on nine discharge measurements made during April to June, 1905. It is well defined between gage heights 0.9 foot and 3 feet.

Station rating table for Strawberry Creek in Strawberry Valley, Utah, from July 2 to November 25, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.25	23	1.35	31	1.45	39	1.50	44
1.30	27	1.40	35				

NOTE.—The above table is based on three discharge measurements made during July, 1905. It is well defined.

Estimated monthly discharge of Strawberry Creek in Strawberry Valley, Utah, for 1905.

Month	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 13-30	400	68	192	6,855
May	362	139	225	13,840
June	274	50	129	7,676
July	44	27	34.6	2,128
August	29	23	26.1	1,605
September	45	25	30.7	1,827
October	42	29	32.5	1,998
November	38	31	35.0	2,083
December [a]	35	35	35.0	2,152
The period				40,160

[a] Daily discharge estimated at 35 second-feet, based on five discharge measurements.
NOTE.—Daily discharge interpolated for missing gage heights.

INDIAN CREEK IN STRAWBERRY VALLEY, UTAH.

This station was established April 5, 1905. It is located in the canyon about 250 feet above the junction of the creek with Strawberry Creek. It is about 1 mile below the point where Indian Creek leaves Indian Creek Valley and enters the canyon, and is 40 miles from Heber, the nearest post-office. The records will show the amount of water that can be diverted from Indian Creek into the Strawberry Valley storage reservoir.

The channel is straight for about 25 feet above and below the station. The right bank is vertical for about 1½ feet above the bed and then slopes gradually upward; the left bank slopes irregularly from the bed. Both banks are sufficiently high to prevent overflow. The bed of the stream is smooth and rocky and is not liable to shift. A slight growth of moss occurs in the summer, but does not interfere with the rating curve to any great extent. The velocity is medium and the discharge ranges from 20 to 100 second-feet. Definite information in regard to winter conditions is lacking.

Discharge measurements are made from two poles laid across the stream. The initial point for soundings is at the right bank.

The gage, which was read during 1905 by the men at the Reclamation Service camp in Strawberry Valley, under the direction of T. C. Callister, is a large stake driven into the bed about 180 feet above the measuring section. It is referred to a bench mark consisting of a cross on a large sandstone bowlder 50 feet south of the river; elevation, 16.28 feet above the zero of the gage and 7,480 feet above mean sea level.

Discharge measurements of Indian Creek in Strawberry Valley, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 15	T. C. Callister	16	16	0.87	1.00	13.5
April 18	do	17	14	.91	1.00	13
April 25	J. Thomas	18	18	1.56	1.20	28
April 26	T. C. Callister	18	20	1.95	1.38	40
May 15	do	16	14	1.39	1.10	18.7
June 17	do	16	13	1.72	1.10	22
October 14	do	16	8.3	1.10	.92	9.1
December 9[a]	A. B. Larson	14	16	.63	1.46	10.1
December 10[a]	do	14	12	.78	1.25	9.8
December 11[a]	do	12	18	.72	1.67	12.8
December 13[a]	do	14	25	.52	1.81	12.9
December 19[a]	do	13	23	.47	2.08	10.9

[a] Ice measurement.

Discharge measurements of Indian Creek at point of diversion in Strawberry Valley, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 21	T. C. Callister	16	6.8	1.12	0.71	7.6
May 3	Callister and Thomas	18	11	1.34	.92	15
May 5	T. C. Callister	18	16	1.62	1.11	25
May 17	do	18	16	1.62	1.11	25
May 19	do	18	19	1.77	1.3	33
May 21	do	19	21	1.78	1.41	37

Daily gage height, in feet, of Indian Creek in Strawberry Valley, Utah, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.1	1.2	1.02	1.0	0.95			1.2
2		1.13	1.2	1.02	1.0	.95	0.96		1.2
3		1.12	1.21	1.02	1.0		.95		1.16
4		1.1	1.2	1.02	1.0	.95	.93	0.92	1.11
5		1.08	1.2	1.02	1.0	1.0	.93		1.1
6		1.06	1.19	1.02	.98		.93	.92	1.1
7		1.06	1 18	1.02	.98	1.0	.93		1.3
8		1.1	1.17	1.02	.97	.98		.91	1.44
9		1.11	1.16	1.01	.98	.96	.93		1.46
10		1.11	1.13	1.01			.92	.92	1.25
11		1.1	1.11	1.0	1.0		.93		1.67
12		1.1	1.12	1.0	.99	.95			1.75
13		1.11	1.12	1.0	1.0	.94	.92	.86	1.81
14	1.0	1.09	1.11	1.0	.99		.92		1.9
15	1.0	1.1	1.11	1.01	.98				1.94
16	1.01	1.12	1.11	1.0	.97	.94	.92		2.0
17	1.02	1.19	1.1	1.0			.92		2.01
18	1.0	1.22	1.11	1.0		.95			2.03
19	1.02	1.3	1.1	.99	.96	.94	.95		2.08
20	1.04	1.31	1.08	1.0	.96	.93	.93		2.09
21	1.14	1.34	1.08	1.0	.96				2.16
22	1.15	1.37	1.06	1.0	.97	.95	.92		
23	1.15	1.39	1.05	1.0	.95	.93		.88	
24	1.36	1.35	1.05	1.0					
25	1.56	1.32	1.05	1.0		.98	.92	.87	
26	1.25	1.31	1.04	1.0		.95	.92	.88	
27	1.14	1.3	1.04	.98		.94	.92	1.0	
28	1.15	1.29	1.03	1.0	.97			1.2	
29	1.07	1.28	1.04	1.0	.97	1.01	.94	1.58	
30	1.07	1.24	1.03	1.0	.98	.99		1.4	
31		1.24		1.0	.97		.96		

NOTE.—Creek frozen November 27 to December 31.

Station rating table for Indian Creek in Strawberry Valley, Utah, from April 14 to November 26, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	8.2	1.10	20	1.30	35	1.50	51
1.00	13.2	1.20	27	1.40	43	1.60	59

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905. It is well defined between gage heights 0.9 foot and 1.4 feet.

Estimated monthly discharge of Indian Creek in Strawberry Valley, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
April 14-31	56	13	22.3	752
May	42	17	27.1	1,666
June	28	15	20.9	1,244
July	15	12	13.6	836
August	13	11	12.1	744
September	14	10	11.1	660
October	11	9	9.8	603
November	11	6.5	8.4	500
December [a]	11	11	11.0	676
The period				7,681

[a] Daily discharge estimated at 11 second-feet, based on five measurements.
NOTE.—Daily discharge interpolated for missing gage heights.

Table of evaporation at Fort Duchesne, Utah, for 1904.

Month.	Total evaporation in inches.
August 26-27	0.35
September	3.18
October	1.84
November 1-16	.43
Total for period	5.80
Average daily evaporation	0.0734

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Duchesne River basin in 1904:

Miscellaneous discharge measurements made in Duchesne River drainage basin 1904.

Date.	Stream.	Locality.	Gage height.	Discharge.
			Feet.	*Sec.-ft.*
April 21	Duchesne	Myton, Utah	6.20	901
April 22	do	do	6.08	766
May 19	do	do	8.13	3,289

PRICE RIVER DRAINAGE BASIN.

PRICE RIVER NEAR HELPER, UTAH.

Price River rises in the Wasatch Mountains, in the southeastern part of Utah County, flows in a general southeasterly direction, and unites with Green River at a point about 14 miles above Greenriver, Utah. The main source of supply is the snow in the upper reaches of the basin, where elevations range from 8,000 to 9,000 feet. The region is extremely rough and rugged. The principal rock is a loose and badly disintegrated sandstone. There is but little soil and practically no vegetation except for small groves of scrubby cedar and a few scattered pines. The original scanty underbrush and grass have been almost entirely tramped out by sheep and cattle. The river is subject to floods in the spring and early summer, during which time it carries immense quantities of sediment. Gordon and Pleasant creeks are the main tributaries. They are both short, steep streams and enter the river from the west almost at right angles.

The gaging station was established February 21, 1904. It is located on the upper side of the ford near the settlement of Spring Glen, about 3 miles south of Helper, Utah, and 350 feet west of the main line of the Denver and Rio Grande Railroad.

The channel is straight for about 125 feet above and 400 feet below the station, and the banks are sufficiently high to prevent any overflow. The bed of the stream is composed of fine gravel and sand and shifts slightly, especially during high water. Information in regard to winter conditions is incomplete.

Low-water measurements are made by wading. The initial point for soundings is a 2 by 4 inch post driven in the left bank S. 8° W., 2½ feet from the gage. The course of the section is N. 44° W. A 2 by 4 inch post marks the position of the gaging station on the right bank. Measurements during high water are impossible, as there is no provision for crossing except by wading.

The gage, which was read daily during 1905 by John Tryon, is a staff driven into the stream bed and supported at the top by a timber buried in the bank. The gage is referred to bench marks as follows: (1) A Standard United States Geological Survey cap cemented in a sandstone bowlder embedded in the bank at a point S. 65° E. 23 feet from the gage; elevation, 12.55 feet above the zero of the gage, and so marked. (2) A cross chiseled on a large bowlder embedded in the bank S. 6° E. 19.2 feet from the gage, marked "B. M.;" elevation, 11.19 feet above the zero of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 128–130.

Discharge measurements of Price River near Helper, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 21	C. Tanner	38	25	0.87	3.35	22
February 17	W. G. Swendsen	48	37	1.02	3.40	38
March 17	do	52	50	1.36	3.65	68
April 25	do	55	63	1.88	3.95	119
May 13	do	53	78	1.96	4.00	154
June 2	do	79	153	3.76	4.92	575
August 24	A. B. Larson	47	24	.48	3.22	11.5

Daily gage height, in feet, of Price River near Helper, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.35	3.45	3.55	4.5	4.9	3.5	3.4	3.2	3.5	3.3	3.3
2	3.3	3.35	3.45	3.6	4.5	4.9	3.4	3.4	3.2	3.5	3.3	3.3
3	3.35	3.35	3.45	3.65	4.5	4.9	3.4	3.5	3.2	3.4	3.4	3.3
4	3.3	3.35	3.45	3.65	4.3	4.9	3.4	3.4	3.2	3.4	3.4	3.3
5	3.3	3.35	3.45	3.65	4.2	4.9	3.4	3.4	3.3	3.4	3.3	3.3
6	3.3	3.35	3.45	3.45	4.2	4.8	3.4	3.4	3.4	3.4	3.3	3.3
7	3.3	3.4	3.45	3.15	4.1	4.6	3.4	3.4	3.4	3.4	3.3	3.2
8	3.3	3.4	3.5	3.15	4.2	4.6	3.4	3.3	3.4	3.4	3.3	3.2
9	3.3	3.4	3.45	3.15	4.2	4.5	3.4	3.3	3.4	3.4	3.3	3.2
10	3.3	3.4	3.45	3.15	4.1	4.5	3.4	3.3	3.4	3.4	3.3	3.3
11	3.3	3.4	3.5	3.25	4.0	4.4	3.4	3.4	3.4	3.3	3.3	3.3
12	3.3	3.4	3.4	3.35	4.0	4.3	3.4	3.4	3.3	3.3	3.3	3.3
13	3.4	3.55	3.55	3.35	4.0	4.2	3.4	3.4	3.3	3.3	3.3	3.2
14	3.3	3.6	3.55	3.35	4.1	4.2	3.4	3.3	3.3	3.3	3.3	3.3
15	3.3	3.6	3.55	3.45	4.1	4.2	3.4	3.3	3.2	3.3	3.3	3.2
16	3.3	3.6	3.55	3.5	4.1	4.1	3.4	3.2	3.2	3.3	3.3	3.2
17	3.4	3.6	3.65	3.45	4.3	4.1	3.4	3.2	3.2	3.3	3.3	3.2
18	3.3	3.4	3.65	3.45	4.4	4.1	3.3	3.2	3.2	3.3	3.4	3.2
19	3.3	3.4	3.65	3.45	4.6	4.1	3.3	3.2	3.2	3.3	3.3	3.2
20	3.3	3.4	3.65	3.45	4.8	3.9	3.3	3.2	3.2	3.3	3.3	3.2
21	3.35	3.4	3.65	3.4	4.9	3.9	3.3	3.2	3.2	3.3	3.3	3.2
22	3.35	3.4	3.6	3.4	4.9	3.8	3.3	3.2	3.2	3.4	3.3	3.2
23	3.35	3.5	3.55	3.4	4.9	3.8	3.3	3.2	3.2	3.4	3.4	3.3
24	3.35	3.45	3.55	3.4	4.9	3.7	3.3	3.2	4.5	3.4	3.4	3.2
25	3.35	3.45	3.65	3.95	5.0	3.6	3.4	3.2	3.5	3.4	3.4	3.2
26	3.35	3.5	3.65	4.0	5.0	3.6	3.3	3.2	3.4	3.4	3.3	3.2
27	3.35	3.5	3.6	4.2	5.0	3.6	3.3	3.3	3.3	3.4	3.4	3.2
28	3.35	3.5	3.55	4.3	5.1	3.5	3.3	3.2	3.3	3.4	3.3	3.2
29	3.35	.....	3.55	4.3	5.1	3.5	3.3	3.3	6.8	3.4	3.2	3.2
30	3.35	.....	3.45	4.4	5.1	3.5	3.3	3.3	3.6	3.4	3.3	3.2
31	3.35	.....	3.45	.....	4.9	3.5	3.4	3.3	.....	3.3	.....	3.1

NOTE.—These gage heights are liable to some error. Observer made no report of ice conditions, but it is probable that the river was frozen for short periods.

Station rating table for Price River near Helper, Utah, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	4	3.60	60	4.10	182	4.60	404
3.20	9	3.70	78	4.20	219	4.70	455
3.30	18	3.80	98	4.30	260	4.80	508
3.40	30	3.90	122	4.40	305	4.90	563
3.50	44	4.00	150	4.50	354	5.00	620

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904-1905. It is well defined between gage heights 3.2 feet and 4.9 feet.

Estimated monthly discharge of Price River near Helper, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January [a]	30	18	21.1	1,297
February	60	24	36.3	2,016
March	69	37	49.8	3,062
April	305	6	71.5	4,254
May	678	150	379	23,300
June	563	44	254	15,110
July	44	18	25.8	1,586
August	44	9	18.8	1,156
September	1,740	9	87.8	5,224
October	44	18	26.3	1,617
Novemner	30	9	20.5	1,220
December [a]	18	4	12.0	738
The year	1,740	4	83.6	60,580

[a] No ice record, discharge applied as for open channel.

GRAND RIVER DRAINAGE BASIN.

AREA AND EXTENT.

Grand River and its tributaries drain an area comprising approximately 26,180 square miles, of which 22,290 are in Colorado and the rest in eastern Utah. East and southeast the basin is limited by the high ranges of the Continental Divide, which separate it from the basins of the Platte and the Arkansas rivers. On the north are the White River and Book Cliffs plateaus, while westward it extends to the canyon district of the Colorado.

The tributaries include innumerable small creeks and five large streams, viz, Blue, Eagle, Roaring Fork, Gunnison, and Dolores rivers.

In the following account of the work of the United States Geological Survey in this region during 1905 the basin has been subdivided, the main river being described first and the tributaries afterwards in their order, from the head down.

GRAND RIVER.

DESCRIPTION OF BASIN.

Grand River rises on the western slopes of the Rocky Mountains among the high peaks of the Front Range, flows in a general southwesterly direction across Colorado into Utah, and unites with Green River to form the Colorado. From source to mouth the total distance traversed is about 350 miles.

In most respects the Grand is a typical mountain stream, flowing throughout its course in a succession of deep canyons, with precipitous and ofttimes perpendicular walls varying in height up to 3,000 feet above the water's edge, alternating with long, narrow, fertile valleys.

The headwater region, comprising approximately 50 per cent of the basin, consists of a long stretch of the western portion of the Continental Divide, extending from the north-central portion of Colorado southward nearly to the Colorado-New Mexico line, a distance of 260 miles, and separating the waters of the Grand from those of the Platte and Arkansas basins. The area is extremely rugged, elevations ranging from 7,000 to 14,000 feet. Gradients are steep, stream channels are numerous, and tributaries are rapid, the fall varying from 20 to 150 feet. The streams of this region derive their waters chiefly from the snow masses on the Continental Divide and furnish the perennial discharge of the Grand. The intermediate or middle portion of the basin, consisting largely of broken and scoured plateaus of sedimentary origin, contributes a relatively small amount of the run-off, the tributaries being

few and, with the exception of Gunnison River, insignificant. The lower portion of the basin, immediately adjacent to the Colorado-Utah State line, is an arid, much eroded region, furnishing an appreciable run-off, which carries a large amount of sediment.

The largest tributaries of the headwater region are Frazer, Williams Fork, Troublesome, Blue, and Muddy rivers, which add their waters to the Grand before it leaves Middle Park. Eagle River comes in near Eagle, just above the point where the river enters Grand River Canyon, and Roaring Fork unites with it just below the mouth of the canyon at Glenwood Springs. At Grand Junction, Colo., the river receives the waters of its largest tributary, Gunnison River, and thereafter no other stream of importance enters until the Dolores comes in, 15 miles west of the Utah boundary.

A peculiar feature of the drainage is what might be termed its one-sided nature, practically all its important tributaries entering the river from the east. That part of the basin lying north and west of the Grand is much less extensive in area, is lower, and is generally broken and barren, and a considerable portion of the waters of its streams is diverted for irrigation.

The geological formations of the basin range from the granite and masses of igneous origin on the crest of the Continental Divide to the younger and less resistant sedimentary rocks of the plateau region. The soils of the upper basin, though shallow, generally contain considerable organic matter; those of the intermediate basin are largely decomposed and disintegrated sedimentary rocks. in the lower basin the soils consist of adobe clays and sandy loams, which grade imperceptibly from one to the other. The scant vegetation of the lower basin renders soil erosion large.

The mountainous portion of the basin is still well covered with forests of spruce, quaking aspen, cedar, and pinon, and the forestation of the intermediate basin is fair. The controlling vegetation of the lower basin is sagebrush, chico, and cactus pads, with scattered pines, cedars, and pinons.

The precipitation ranges from 5 to 10 inches in the lower basin, 10 to 20 inches in the intermediate region, and 20 to 30 inches in the headwater region. By far the greater part of this is in the form of snow.

Natural storage within the basin is limited to a few small, high, mountain lakes. The stream channels of the upper basin are bordered to some extent by flat bottom lands, which are used as meadows and which are irrigated by a large number of small ditches. In the intermediate basin are a few small reservoirs storing snow and flood waters. A number of pumping plants also draw upon this district. Irrigation is extensively practiced in the Uncompahgre, Gunnison, and Grand valleys, and a large project now under construction by the Reclamation Service will require 1,200 second-feet of the discharge of Gunnison River. The immense power possibilities of the Grand are at present but little developed.

NORTH FORK OF GRAND RIVER NEAR GRAND LAKE, COLO.

This station was established July 29, 1904. It is located at the highway bridge between Grand Lake and Hot Sulphur Springs, Colo., about 3 miles southwest of Grand Lake post-office, in T. 3 N., R. 76 W. The nearest railroad station is at Granby, on the Denver, Northwestern and Pacific, 15 miles distant.

The channel is straight for about 500 feet above and for 150 feet below the station. Both banks are about 2 feet high and are covered with heavy sod, willows, and scattered pine trees. The ground slopes upward from the top of the banks rather abruptly, so that even at very high stages the overflow is confined to a comparatively narrow channel. The bed of the stream at the station and for a considerable distance above and below is covered with large bowlders, which at high water cause a boiling and wave motion and at low stages eddies and in some places dead water. The channel is very rough and has a great fall. There is but one channel at all stages. The ordinary range of gage heights is about 3 feet. Gage readings are impracticable during the winter months owing to the formation of ice at the rod. The section is not entirely satisfactory, but it is the best available.

Discharge measurements are made at the higher stages from the downstream side of the single-span wooden bridge to which the gage is attached. The initial point for soundings is a 10-penny nail driven into the bridge floor over the north face of the right abutment and marked zero with black paint.

The gage, which was read twice each day during 1905 by G. W. Carr, is a staff attached vertically to the downstream edge of the right abutment of the bridge. The gage reads from 2 to 10.3 feet, the 2-foot mark resting on the bed of the stream. The bench mark is a 10-penny nail driven into a notch cut in the northeast root of a 12-inch pine tree which stands at the right end of the bridge on the downstream side; elevation, 8.36 feet above the zero of the gage. The elevation of the station above sea level is about 8,400 feet.

A description of this station with gage-heights and discharge data is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 130-132.

Discharge measurements of North Fork of Grand River near Grand Lake, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 5	W. A. Lamb	39	80	1.80	4.10	144
May 30	do	43	122	3.47	4.80	423
June 11	do	53	159	4.99	5.60	793
June 30	do	52	137	4.20	5.20	576
July 7	do	39	99	3.08	4.60	305
July 26	do	39	87	1.59	4.15	138
August 2	do	39	80	1.28	4.00	102
August 16	do	39	63	1.02	3.76	64
September 9	do	38	55	.75	3.60	41
September 18	do	38	49	.65	3.49	32

Daily gage height, in feet, of North Fork of Grand River near Grand Lake, Colo., for 1905.

Day.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	4.38	5.2	5.05	4.02	3.58	3.55	3.48	4.28
2	3.3	4.4	5.22	5.05	4.0	3.6	3.52	3.5	3.45
3	3.3	4.3	5.4	4.95	3.98	3.62	3.5	3.62	3.4
4	3.3	4.2	5.8	4.7	3.98	3.68	3.5	3.68	3.38
5	3.3	4.08	5.8	4.6	3.92	3.62	3.5	3.6	3.4
6	3.35	3.95	5.78	4.6	3.9	3.6	3.48	3.58	3.88
7	3.3	4.12	5.8	4.55	3.88	3.6	3.45	3.48	3.8
8	3.3	4.28	5.88	4.62	3.82	3.58	3.45	3.35	3.4
9	3.35	4.35	6.2	4.6	3.8	3.55	3.48	3.38	3.38
10	3.3	4.25	6.1	4.58	3.8	3.55	3.48	3.45	3.85
11	3.3	4.12	5.6	4.58	3.82	3.55	3.5	3.5	3.65
12	3.35	4.1	5.7	4.5	4.02	3.5	3.5	3.5	.....
13	3.4	4.15	5.85	4.55	3.98	3.5	3.5	3.45	.....
14	3.4	4.1	5.7	4.52	3.85	3.5	3.5	3.5	.....
15	3.4	4.1	5.75	4.62	3.8	3.48	3.5	3.45	.....
16	3.4	4.3	5.85	4.58	3.78	3.48	3.5	3.35	.....
17	3.42	4.6	5.68	4.52	3.72	3.45	3.5	3.38	.....
18	3.5	4.72	5.45	4.45	3.7	3.5	3.48	3.4	.....
19	3.48	4.75	5.35	4.3	3.7	3.52	3.42	3.55	.....
20	3.5	4.8	5.2	4.3	3.68	3.5	3.52	3.5	.....
21	3.52	4.88	5.3	4.32	3.65	3.5	3.65	3.45	.....
22	3.52	4.95	5.3	4.22	3.62	3.5	3.68	3.4	.....

Daily gage height, in feet, of North Fork of Grand River near Grand Lake, Colo., for 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
23	3.55	5.1	5.38	4.15	3.6	3.48	3.62	3.4	.....
24	3.58	5.02	5.65	4.15	3.6	3.45	3.6	3.5	.....
25	3.6	4.92	5.75	4.18	3.6	3.5	3.52	3.52	.....
26	3.62	4.88	5.7	4.12	3.6	3.5	3.5	3.55	.....
27	3.75	4.92	5.7	4.15	3.6	3.48	3.5	3.45	.....
28	3.92	4.95	5.55	4.15	3.6	3.45	3.5	3.4	.....
29	4.02	4.88	5.42	4.1	3.68	3.45	3.5	3.4	.....
30	4.15	4.85	5.35	4.1	3.62	3.52	3.48	3.5	.....
31	.....	5.05	.....	4.05	3.6	.....	3.45	.....	.....

NOTE.—Ice conditions during December.

Station rating table for North Fork of Grand River near Grand Lake, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	17	4.10	130	4.90	434	5.70	861
3.40	24	4.20	160	5.00	479	5.80	927
3.50	33	4.30	194	5.10	526	5.90	996
3.60	43	4.40	230	5.20	575	6.00	1,067
3.70	55	4.50	267	5.30	627	6.10	1,141
3.80	69	4.60	306	5.40	681	6.20	1,220
3.90	85	4.70	347	5.50	738		
4.00	105	4.80	390	5.60	798		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 3.5 feet and 5.6 feet.

Estimated monthly discharge of North Fork of Grand River near Grand Lake, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	145	17	35.8	2,1[illegible]
May	526	95	291	17,8[illegible]
June	1,220	575	816	48,560
July	502	118	254	15,63[illegible]
August	110	43	67.5	4,1[illegible]
September	53	28	35.7	2,1[illegible]
October	53	26	34.2	2,1[illegible]
November	53	20	31.1	1,85[illegible]
The period	.....	.....	.....	94,43[illegible]

GRAND LAKE OUTLET AT GRAND LAKE, COLO.

This station was established July 31, 1904. It is located at the footbridge at the west end of Grand Lake, about one-half mile south of Grand Lake post-office, Colo., in sec. 6, T. 3 N., R. 75 W. The nearest railroad station is 18 miles distant, at Granby, on the Denver, Northwestern and Pacific Railway.

The channel is straight for about 300 feet above and for 150 feet below the boat station. Both banks are about 3 feet high, and their level tops are covered with white pine trees. The stream does not overflow at this point, which is one-fourth mile below the gage and outlet. The current is swift at high water and medium at lower stages. The bed of the stream is composed of gravel and cobblestones and is firm and free from vegetation. At the gage both banks are low and are liable to overflow. There is but one channel at all stages. Gage heights have an ordinary range of 2.5 feet. Ice conditions render gage readings impracticable during the winter months.

High-water measurements are made from a boat at a ford about one-fourth mile below the gage. Points for soundings are marked at 5-foot intervals by tin tags fastened to a wire stretched across the stream 50 feet above the ford. The initial point for soundings is the tree to which the wire is fastened on the right bank. At ordinary and low stages measurements are made by wading at convenient points below the gage.

The gage, which was read twice each day during 1905 by J. W. Davies, is a staff attached vertically to the southeast corner of the second pier from the north end of the footbridge, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows: (1) A cross on the top of a large granite bowlder 85 feet south of the left bank of the outlet and 40 feet west of the lake, marked with black paint "U. S. G. S. B. M." elevation, 12.05 feet above the zero of the gage. (2) A cross cut in the top of a granite bowlder 1,198 feet north from the initial point for soundings and marked "B. M.;" elevation, 14.93 feet above the zero of the gage. Elevation above sea level is about 8,500 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 132–134.

Discharge measurements of Grand Lake Outlet at Grand Lake, Colo., in 1905.

Date.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 4	Wm. A. Lamb	48	49	1.53	2.00	75
May 31	do	56	105	3.28	2.90	345
June 11	do	170	347	2.39	3.88	830
July 1	do	156	275	2.13	3.42	585
July 8	do	151	222	1.39	2.77	308
July 27	do	120	137	1.34	2.42	184
August 3	do	126	124	1.07	2.21	133
August 17	do	49	47	1.40	1.95	66
September 11	do	36	34	.82	1.62	28
September 18	do	36	30	.57	1.50	17

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Grand Lake Outlet at Grand Lake, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.34	1.92	3.22	3.37	2.34	1.76	1.48
2	1.36	2.02	3.46	3.24	2.28	1.74	1.48
3	1.38	2.04	3.64	3.01	2.22	1.62	1.48
4	1.39	2.0	3.98	2.82	2.19	1.66	1.48
5	1.39	1.96	4.18	2.74	2.16	1.68	1.48
6	1.39	1.9	4.03	2.71	2.13	1.68	1.47
7	1.39	1.85	4.02	2.7	2.1	1.69	1.45
8	1.39	1.84	4.11	2.74	2.06	1.7	1.43
9	1.4	1.92	4.44	2.72	2.03	1.68	1.42
10	1.48	1.96	4.21	2.71	2.0	1.66	1.4
11	1.52	1.96	3.9	2.75	2.0	1.65	1.39

Daily gage height, in feet, of Grand Lake Outlet at Grand Lake, Colo., for 1905—**Continued.**

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
12	1.54	1.92	3.9	2.78	2.06	1.62	1.38
13	1.54	1.9	4.0	2.75	2.08	1.59	1.37
14	1.54	1.9	3.9	2.74	2.06	1.58	1.38
15	1.56	1.87	3.98	2.76	2.04	1.54	1.39
16	1.56	1.86	4.12	2.76	2.0	1.54	1.4
17	1.57	1.96	3.72	2.68	1.94	1.52	1.42
18	1.57	2.12	3.69	2.62	1.9	1.5	1.44
19	1.58	2.24	3.46	2.56	1.86	1.49	1.45
20	1.62	2.36	3.32	2.56	1.84	1.49	1.46
21	1.62	2.48	3.4	2.54	1.82	1.49	1.44
22	1.63	2.66	3.38	2.52	1.8	1.48	1.44
23	1.64	2.94	3.46	2.47	1.78	1.47	1.42
24	1.64	3.06	3.66	2.42	1.78	1.46	1.42
25	1.64	2.96	3.76	2.4	1.78	1.44	1.42
26	1.64	2.88	3.87	2.42	1.8	1.44	1.43
27	1.66	2.9	3.84	2.43	1.79	1.44	1.43
28	1.72	2.97	3.74	2.41	1.8	1.44	1.43
29	1.76	2.89	3.66	2.41	1.8	1.45	1.44
30	1.82	2.8	3.56	2.42	1.8	1.48	1.47
31	.....	2.9	.....	2.38	1.8	.....	1.46

Station rating table for Grand Lake Outlet at Grand Lake, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	10	2.20	122	3.10	433	4.00	900
1.40	13	2.30	148	3.20	479	4.10	956
1.50	18	2.40	176	3.30	527	4.20	1,013
1.60	25	2.50	207	3.40	578	4.30	1,071
1.70	34	2.60	240	3.50	630	4.40	1,130
1.80	46	2.70	275	3.60	682	4.50	1,190
1.90	60	2.80	312	3.70	735		
2.00	77	2.90	350	3.80	789		
2.10	98	3.00	390	3.90	844		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905 and is well defined.

Estimated monthly discharge of Grand Lake Outlet at Grand Lake, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
April	49	11	22.7	1,351
May	416	52	168	10,330
June	1,154	489	785	46,710
July	563	170	267	16,420
August	159	44	76.2	4,685
September	41	15	23.7	1,410
October	17	12	14.7	904
The period	.....	.....	.....	81,810

NORTH INLET TO GRAND LAKE AT GRAND LAKE, COLO.

This station was established August 3, 1905. It is located at the footbridge which crosses the stream about 100 yards north of the mouth and 300 yards east of Grand Lake post-office, in sec. 5, T. 3 N., R. 75 W.

The channel is straight for 300 feet above and for 200 feet below the station. The right bank is low, is covered with grasses and scattered willows and white pine trees, and at high stages overflows to a considerable extent. The left bank is high and is covered with a dense growth of white pines and underbrush. The bed of the stream is composed of large cobblestones and gravel and is permanent. There is but one channel at all ordinary stages, broken by the middle pier of the bridge. The current is swift at high and medium at low water.

High-water measurements are made from the upstream side of the two-span footbridge. The initial point for soundings is a 40-penny nail driven in the top of the west end of the north stringer of the bridge, 97 feet from bench mark No. 2. The point is marked with black paint. Low-water measurements are made by wading at convenient points above the bridge.

The gage, which was read twice each day during 1905 by J. Cairns, is a 4-foot timber fastened to the west face of the outer pier of the bridge. It is referred to bench marks as follows: (1) A 40-penny nail driven horizontally in the west face of a white pine tree 8 inches in diameter located on the left bank of the stream, 20 feet northeast of the east end of the bridge, marked "U. S. B. M.;" elevation, 5.32 feet above the zero of the gage. (2) A 40-penny nail driven horizontally in the east face of a white pine tree 1 foot in diameter located on the right bank of the stream 97 feet west of the initial point for soundings; elevation, 4.43 feet above the zero of the gage.

Discharge measurements of North Inlet to Grand Lake at Grand Lake, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 4	W. A. Lamb	48	43	1.37	2.30	58
May 31	do	50	111	1.84	3.05	204
July 27	do	48	53	1.62	2.40	86
August 3	do	40	50	1.36	2.30	68
September 11	do	34	23	.61	1.90	14
September 18	do	30	15	.63	1.85	9.4

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of North Inlet to Grand Lake at Grand Lake, Colo., for 1905.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.0	1.8	1.85	1.85	17	2.1	1.9	1.8	1.9	1.8
2		2.0	1.8	1.85	1.8	18	2.1	1.9	1.8	1.9	1.8
3	2.3	1.9	1.8	1.85	1.8	19	2.0	1.9	1.8	1.9	1.8
4	2.3	1.9	1.8	1.85	1.8	20	2.0	1.9	1.85	1.9	1.8
5	2.3	1.9	1.8	1.9	1.8	21	2.0	1.9	1.95	1.9	1.8
6	2.3	1.9	1.8	1.9	1.8	22	2.0	1.9	1.9	1.9	1.8
7	2.3	2.0	1.8	1.9	1.8	23	2.0	1.9	1.9	1.9	1.8
8	2.2	1.9	1.8	1.9	1.8	24	2.0	1.8	1.9	1.9	1.8
9	2.2	1.9	1.8	1.9	1.8	25	2.0	1.8	1.85	1.9	1.8
10	2.2	1.9	1.8	1.9	1.8	26	2.0	1.8	1.85	1.9	1.8
11	2.2	1.9	1.8	1.9	1.8	27	2.0	1.8	1.8	1.9	1.8
12	2.2	1.9	1.8	1.9	1.8	28	2.0	1.8	1.8	1.9	1.8
13	2.2	1.9	1.8	1.9	1.9	29	2.0	1.8	1.85	1.9	1.8
14	2.2	1.9	1.8	1.9	1.9	30	2.0	1.8	1.9	1.9	1.8
15	2.15	1.9	1.8	1.9	1.9	31	2.0		1.95		1.8
16	2.1	1.9	1.8	1.9	1.9						

GRAND RIVER AT HOT SULPHUR SPRINGS, COLO.

This station was established July 27, 1904. It is located at the highway bridge one-eighth mile below Hot Sulphur Springs, Colo., in sec. 3, T. 1 N., R. 78 W., and is 5 miles above the mouth of Williams Fork River.

The channel is straight for about 200 feet below the station. Above the station it is curved at almost a right angle. Both banks are high and can not overflow. The bed of the stream is composed of bed rock, heavy gravel, and large bowlders on the right side, while on the left side it is a sloping gravel bar extending outward to the left abutment of the bridge. It is free from vegetation and, except for the gravel bar, is permanent. There is but one channel at all stages broken by the two piers of the bridge. The current is swift and at low water passes under the bridge squarely. At high water the current in the greater part of the section passes under the bridge at an angle. The accuracy of measurements is affected by the boiling of the water at the piers and by the large bowlders in the channel beneath the bridge. During the spring and early summer of 1905 the channel 100 feet below the station was somewhat obstructed by large bowlders which were blasted from a railroad cut on the right bank. This obstruction backs the water up on the gage to a considerable extent and at extreme low stages causes dead water in a portion of the cross sections.

Discharge measurements, except at very low stages, are made from the upstream side of the three-span bridge. The initial point for soundings is located over the inner face of the right abutment and is marked with a circle on the upstream hub rail. A stay line is located 30 feet above the bridge.

The gage, which was read once each day during 1905 by Mrs. Carrie Wills, consists of a vertical staff, bolted vertically to the downstream end of the first pier from the right bank. The gage reads from 2 to 10.8 feet, the 2-foot mark resting on bed rock. The gage is referred to bench marks as follows: (1) A cross painted on the north pier above the gage rod; elevation, 16.48 feet above the zero of the gage. (2) A cross cut in the top of a bench on the northwest face of a sandstone cliff on the east side of the road 50 feet south of the bridge; elevation, 25.49 feet above the zero of the gage. The elevation of the station above sea level is approximately 6,550 feet.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper, No. 133, United States Geological Survey, pages 135–137.

Discharge measurements of Grand River at Hot Sulphur Springs, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 1	W. A. Lamb	80	401	3.16	5.22	1,268
May 6	do	66	333	2.14	4.40	722
May 29	do	97	517	5.10	6.55	2,638
June 3	do	106	665	6.27	7.85	4,167
June 9	do	102	782	7.33	9.15	5,733
July 5	do	74	446	3.46	5.52	1,542
July 25	do	70	359	2.10	4.58	731
August 16	do	63	269	1.28	3.95	346
August 29	do	58	279	.99	3.74	277
September 9	do	58	284	.99	3.60	281
September 15	do	54	250	.81	3.45	203
October 2	do	54	251	.73	3.43	183

Daily gage height, in feet, of Grand River at Hot Sulphur Springs, Colo., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2.65	2.9	5.35	7.4	6.75	4.55	3.35	3.5	3.45
2	2.7	2.95	5.58	7.55	6.35	4.6	3.3	3.5	3.45
3	2.7	2.75	5.38	7.8	6.1	4.6	3.4	3.5	3.45
4	2.68	2.65	4.98	8.5	6.0	4.45	3.4	3.4	3.5
5	2.68	2.75	4.8	8.95	5.45	4.3	3.32	3.4	3.5
6	2.68	2.8	4.58	8.4	5.45	4.3	3.32	3.4	3.5
7	2.68	3.0	4.7	8.5	5.45	4.25	3.4	3.4	3.5
8	2.68	3.15	4.8	9.05	5.42	4.2	3.4	3.4	3.5
9	2.7	3.4	5.2	8.75	5.42	4.22	3.32	3.4	3.5
10	2.65	3.6	4.98	8.25	5.45	4.28	3.3	3.4	3.48
11	2.65	3.58	4.78	8.25	5.42	4.2	3.32	3.4	3.45
12	2.65	3.62	4.7	8.25	5.42	4.05	3.3	3.4	3.42
13	2.65	3.58	4.8	8.0	5.42	4.0	3.32	3.42	3.42
14	2.68	3.55	4.62	8.05	5.42	4.0	3.22	3.48	3.42
15	2.65	3.5	4.62	7.65	5.45	4.02	3.2	3.42	3.42
16	2.68	3.75	4.88	7.55	5.22	4.08	3.2	3.4	3.42
17	2.7	3.6	5.45	7.65	5.18	3.95	3.0	3.4	3.4
18	2.65	3.78	5.85	7.88	5.05	3.92	3.0	3.4	3.4
19	2.65	4.02	6.15	7.85	5.02	3.9	3.4	3.4	3.4
20	2.7	3.95	6.38	7.4	4.98	3.88	3.5	3.4	.....
21	2.65	3.8	6.48	7.4	4.9	3.85	3.4	3.4	.....
22	2.7	3.88	6.72	7.45	4.75	3.8	3.4	3.4	.....
23	2.7	3.95	7.05	7.1	4.58	3.78	3.4	3.4	.....
24	2.65	4.22	7.12	7.15	4.45	3.75	3.4	3.4	.....
25	2.7	4.05	6.75	7.5	4.42	3.58	3.4	3.4	.....
26	2.7	4.08	6.62	7.45	4.42	3.45	3.4	3.4	.....
27	2.65	4.48	6.75	7.5	4.46	3.4	3.4	3.45	.....
28	2.75	4.62	6.85	7.55	4.46	3.4	3.4	3.45	.....
29	2.75	4.65	6.6	7.4	4.46	3.42	3.4	3.45	.....
30	2.8	4.88	6.48	7.1	4.6	3.38	3.48	3.45	.....
31	2.85	.....	6.6	.....	4.6	3.4	.....	3.45	.....

Station rating table for Grand River at Hot Sulphur Springs, Colo., from July 27, 1904, to April 15, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.60	185	2.90	276	3.20	402	3.50	554
2.70	215	3.00	313	3.30	450	3.60	609
2.80	245	3.10	355	3.40	501		

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1904 and is well defined.

Station rating table for Grand River at Hot Sulphur Springs, Colo., from May 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	95	4.20	500	5.40	1,430	7.20	3,360
3.10	110	4.30	560	5.50	1,530	7.40	3,600
3.20	130	4.40	620	5.60	1,630	7.60	3,840
3.30	150	4.50	680	5.70	1,730	7.80	4,080
3.40	180	4.60	750	5.80	1,830	8.00	4,320
3.50	210	4.70	820	5.90	1,930	8.20	4,560
3.60	240	4.80	900	6.00	2,030	8.40	4,800
3.70	280	4.90	980	6.20	2,250	8.60	5,040
3.80	320	5.00	1,060	6.40	2,470	8.80	5,280
3.90	360	5.10	1,150	6.60	2,690	9.00	5,540
4.00	400	5.20	1,240	6.80	2,910	9.20	5,800
4.10	450	5.30	1,330	7.00	3,130		

NOTE.—The above table is applicable only for open-channel conditions. It is based on twelve discharge measurements made during 1905. It is well defined above gage height 3.4 feet. Owing to changing conditions from April 15 to April 30 the above table has been applied indirectly for that period.

Estimated monthly discharge of Grand River at Hot Sulphur Springs, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	260	200	212	13,040
April	1,036	200	550	32,730
May	3,264	736	1,785	109,800
June	5,605	3,240	4,137	246,300
July	2,855	632	1,265	77,780
August	750	174	410	25,210
September	210	95	164	9,770
October	210	180	186	11,440
November 1-19	210	180	195	7,340
The period				533,[illegible]

GRAND RIVER NEAR KREMMLING, COLO.

This station was established July 24, 1904. It is located at the mouth or upper end of Gore Canyon, about 3 miles southwest of Kremmling, Colo.

The channel is straight for about 100 feet above and for 150 feet below the station. The right bank is the grade of the Denver, Northwestern and Pacific Railway; the left bank is abrupt and is covered with bowlders and bushes; neither bank overflows. The bed of the stream is composed of sand, silt, and bowlders and is very shifting, the change in channel being as great as 10 feet in places. The channel scours out during high-water stages and gradually fills up again as the water subsides. There is but one channel at all stages. The current is very sluggish at low water and medium to swift at high water. Gage heights have a range of about 15 feet during an ordinary season. Gage readings in the winter months are somewhat affected by ice in the channel. The shifting of the bed makes the development of a good rating curve a difficult matter. The station is not entirely satisfactory, but it is the best location available below the mouth of Blue River.

Discharge measurements are made from a cable stretched across the river just below the gage and about 150 feet above the wagon bridge. The cable is approximately 280 feet

long and is tagged with tin tags marked every 5 feet from the top of the right bank, which is a high sandstone cliff, to the top of the left bank. The initial point for soundings is the face of the rock to which the cable is anchored on the right bank.

Gage readings at this station were made twice each day during 1905 by J. C. Harper. The original equipment consisted of a wire gage attached to the cantilever arm of the frame to which the gage rod was spiked in a horizontal position. This gage was destroyed by high water in June, 1905, and after the water had subsided the old gage was placed on a new cantilever arm similar to the old one but about 3 feet higher, the gage datum remaining the same and the wire was replaced by a standard chain. The length of the chain is 36.50 feet. Bench mark No. 1 is a cross cut in the east face of a large bowlder on the right bank about 20 feet south of the cable marked with black paint "U.S. B.M.;" elevation, 25.03 feet above the zero of the gage. The elevation above sea level is about 7,250 feet. Bench mark No. 2 is a cross cut and painted block on top of a cone-shaped granite bowlder on the left bank of the river about 50 feet downstream from the gage. Elevation of bench mark above gage datum is 9.57 feet. This bench mark is submerged at high water.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 137–139.

Discharge measurements of Grand River near Kremmling, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28	W. A. Lamb	115	775	2.27	5.24	1,762
May 10	do	118	1,190	1.97	6.48	2,344
May 27	do	141	1,810	3.08	10.98	5,575
June 6	do	160	2,688	4.24	15.14	11,400
June 16	do	150	2,362	3.67	13.05	8,668
June 18	M. C. Hinderlider	142	2,183	3.32	11.81	7,248
June 27	W. A. Lamb	135	1,945	2.97	10.22	5,777
July 13	do	106	1,293	1.49	5.80	1,927
July 22	do	116	1,310	1.30	5.15	1,703
August 10	do	104	920	.93	3.10	852
August 25	do	102	409	1.68	2.38	689
September 5	do	104	380	1.72	2.29	655
September 14	do	100	271	1.85	1.83	500
September 27	do	101	202	2.09	1.60	423

Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.41	0.95	1.09	2.08	6.88	11.83	8.81	4.54	2.90	1.90	1.32	0.92
2	1.36	.97	1.06	2.21	7.50	12.42	8.33	4.27	2.48	1.75	1.23	1.15
3	1.18	.95	1.14	2.03	7.22	12.92	8.04	3.99	2.16	1.85	1.58	1.06
4	1.01	.95	1.09	1.53	6.50	14.03	7.40	3.88	2.22	1.70	1.88	1.13
5	.98	.93	1.06	1.65	5.98	15.42	6.76	3.70	2.32	1.68	1.92	1.18
6	.94	.97	1.16	2.08	5.40	15.25	6.61	3.72	2.40	1.65	1.97	1.06
7	.88	.85	1.19	2.68	5.22	14.46	6.34	3.76	2.52	1.54	1.82	.75
8	.76	.93	1.14	2.61	5.35	14.66	6.32	3.32	2.46	1.50	1.68	.82
9	.78	.83	1.16	2.93	6.40	15.28	6.21	3.38	2.34	1.50	1.56	1.26
10	.98	.75	1.09	3.31	6.38	15.43	5.48	3.18	2.26	1.46	1.44	1.60
11	.96	.84	1.14	3.38	6.45	14.45	5.46	3.15	2.14	1.24	1.20	1.90
12	.88	.80	1.16	3.25	6.54	13.46	5.90	3.56	2.02	1.36	1.21	1.64
13	.88	.95	1.22	3.33	5.65	13.54	5.87	3.76	1.90	1.42	1.32	1.90
14	.86	.95	1.24	3.35	5.68	13.45	5.76	3.44	1.84	1.56	1.60	1.72

Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	.84	.90	1.32	3.05	5.50	12.77	5.98	3.18	1.74	1.64	1.55	1.35
16	.98	1.05	1.39	2.98	5.87	13.06	5.88	3.00	1.68	1.60	1.48	1.22
17	.98	1.05	1.49	2.91	6.99	12.54	5.95	2.76	1.64	1.92	1.65	1.00
18	1.01	1.10	1.44	3.01	7.88	11.75	5.42	2.66	1.66	1.90	1.75	1.08
19	1.04	1.03	1.29	3.48	8.78	11.53	5.36	2.38	1.78	1.82	1.67	.92
20	.88	.93	1.34	3.48	9.61	11.37	5.24	2.48	1.79	1.70	1.20	.63
21	.84	1.03	1.49	3.11	9.78	10.29	5.35	2.41	1.79	1.50	1.28	.70
22	.86	1.05	1.52	3.05	10.52	10.29	5.14	2.32	1.72	1.65	1.48	.65
23	.96	1.07	1.46	3.31	11.31	10.51	4.64	2.29	1.65	1.75	1.45	.64
24	1.04	1.05	1.34	3.68	11.59	10.43	4.50	2.36	1.60	1.82	1.82	.56
25	.98	1.03	1.44	3.71	11.08	10.35	4.46	2.41	1.60	1.82	1.32	.50
26	.78	1.03	1.59	3.48	10.70	10.35	4.45	2.46	1.60	1.61	1.34	.44
27	.79	1.07	2.04	4.11	11.00	10.35	4.42	2.42	1.60	1.66	1.49	.45
28	.86	1.07	1.79	5.05	10.95	10.04	4.51	2.36	1.58	1.83	1.30	.32
29	.81	.....	1.46	5.32	10.44	9.46	4.61	2.48	1.58	1.85	1.08	.28
30	.94	.....	1.49	5.85	10.09	9.32	4.64	2.55	1.68	1.82	.68	.46
31	.96	.....	1.82	.....	10.65	.....	4.66	2.82	.....	1.68	.....	.34

NOTE.—No ice record.

Station rating table for Grand River near Kremmling, Colo., from January 1 to December 31, 1905.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	220	1.60	440	3.00	830	5.80	1,950
.30	230	1.70	465	3.20	900	6.00	2,050
.40	240	1.80	490	3.40	970	6.20	2,170
.50	250	1.90	515	3.60	1,040	6.40	2,290
.60	260	2.00	540	3.80	1,110	6.60	2,410
.70	275	2.10	565	4.00	1,180	6.80	2,530
.80	290	2.20	590	4.20	1,250	7.00	2,670
.90	305	2.30	620	4.40	1,330	7.20	2,810
1.00	320	2.40	650	4.60	1,410	7.40	2,950
1.10	340	2.50	680	4.80	1,490	7.60	3,090
1.20	360	2.60	710	5.00	1,570	7.80	3,250
1.30	380	2.70	740	5.20	1,650	8.00	3,410
1.40	400	2.80	770	5.40	1,750		
1.50	420	2.90	800	5.60	1,850		

[a] From May 14 to July 10, inclusive, the table was applied indirectly, owing to shifting conditions.

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.6 feet and 6.5 feet.

Estimated monthly discharge of Grand River near Kremmling, Colo., for 1905.

[Drainage area, 2,380 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	402	287	314	19,310	0.132	0.152
February	340	282	316	17,550	.133	.138
March	550	332	390	23,980	.164	.189
April	1,975	426	924	54,980	.388	.433
May	6,430	1,660	3,523	216,600	1.48	1.71
June	11,820	4,850	7,999	476,000	3.36	3.75
July	4,340	1,338	2,046	125,800	.860	.992
August	1,386	617	866	53,250	.364	.420
September	800	436	532	31,660	.224	.250
October	520	368	475	29,210	.200	.231
November	532	272	419	24,930	.176	.196
December	515	228	325	19,980	.137	.158
The year	11,820	228	1,511	1,093,000	.635	8.62

GRAND RIVER AT GLENWOOD SPRINGS, COLO.

This station is located in the mountains, midway between the Continental Divide and the Colorado-Utah boundary line, and just above the third large tributary of the Grand, which is called Roaring Fork.

A comparison of the miscellaneous discharge measurements made at the mouth of Roaring Fork, at Glenwood Springs, during 1903 and 1904, with the discharge of the Grand, at Glenwood Springs, shows that the volume of water being discharged by the Roaring Fork augments the volume of water which passes the Glenwood station by 50 per cent. While there is a moderate amount of irrigation of the first bottom lands from the tributaries above this point, relatively little of the run-off of the basin is used.

The station was established May 12, 1899, at the request of the Denver and Rio Grande Railroad Company. It was at first located at the railroad bridge, a quarter of a mile west of the depot and just above the mouth of Roaring Fork; but at the beginning of 1900 it was removed to a point near the electric-light works. The measuring section is located at the State Street Bridge, which crosses the river at the main thoroughfare of Glenwood Springs, and is about 10 feet below the point at which all discharge measurements from 1900 to 1904, inclusive, were made.

The channel at the cable section is straight for a distance of several hundred feet each way. The left bank is the Denver and Rio Grande Railroad embankment and is well protected by a concrete and dry rubble retaining wall. The right bank is a low wall composed of bowlders, without any binding material, and protects the grounds of the Hotel Colorado. At extremely high water these grounds have been flooded, but this is a rare occurrence. The bed of the stream is composed of bowlders and cobblestones and is permanent. A small amount of silt is deposited at low water, but it scours out in the spring and does not change the cross section materially. There is but one channel at all stages. At high water the current is swift, often reaching a velocity as high as 20 feet per second; at low water the current has a moderate velocity. Gage heights range from 2.5 to 12 feet.

Discharge measurements since May 16, 1905, have been made by means of a cable, car, and stay line 60 feet upstream, the cable being anchored to the piers of the State Street Bridge. Measurements from 1900 to 1904, inclusive, were made from the footway which

crosses the stringers of the bridge below the roadway, about 10 feet above the present section. Plottings of old and new cross sections show no material difference.

Gage readings at this station are made by W. H. Richardson, the manager of the Glenwood Electric Light and Power Company, morning and evening each day during the entire year. The first gage was wire, but when the station was removed to the electric-light works a new gage rod was placed. This consisted of a light vertical staff, to the lower end of which was attached a wooden float, which rested on the surface of the water, standing in a well or box made of 6-inch boards. The bottom of this well connected with a small wooden flume extending out into the river, which allowed the water in the well to assume the level of the river surface. In July, 1902, this gage being in bad repair was replaced by an automatic water register, the site being the same as that of the old float gage. The register never worked satisfactorily and was later replaced by another float gage, using the same well and intake flume. The present gage consists of a copper float and counterweight connected with a silk line passing over pulleys so arranged that a rise of 1 foot of the river registers but one-half foot on the rod. By this arrangement the large rise and fall of the river is readily accommodated by a length of gage that would be impossible with a direct-reading gage. The gage rod proper consists of a light pine rod, 1 by 1 inch by 5 feet, securely fastened in a vertical position inside a small house in which the apparatus is located and which sets on top of the vertical well. A pointer attached to a counterweight slides along the gage rod and registers the rise and fall of the river. This gage has given entire satisfaction. The original basis for the installation of this gage and the method of correction since that time is the relation of the depth of water in the well to the gage reading. When the gage reads correctly the difference between the depth of water in the well and the gage reading is 2.25 feet. The bench mark established June 27, 1904, is a cross cut in the top of the foundation capstone of the power house directly in front of the gage house, east of the power-house door, and is indicated by the letters "B.M." cut in the vertical face of the foundation stone on which the bench mark is located. Elevation of bench mark above the datum of the gage is 17.77 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 37, pp 293-294; 50, pp 375-376; 66, p 92; 85, p 48; 100, pp 89-90; 133, pp 139-140.
Discharge: WS 37, p 294; 50, p 376; 85, p 49; 100, p 90; 133, p 140.
Discharge, monthly: Ann 22, iv, p 389; WS 75, p 174; 85, p 50; 100, p 92; 133, p 141.
Gage heights: WS 37, p 294; 50, p 376; 66, p 93; 85, p 49; 100, p 91; 133, p 140.
Hydrographs: Ann 22, iv, p 389; WS 75, p 174.
Rating tables: WS 52, p 520; 66, p 174; 85, p 50; 100, p 91; 133, p 141.

Discharge measurements of Grand River at Glenwood Springs, Colo., in 1905.

Date.	Hydrographer.	Width	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 28	R. I. Meeker	190	508	2.01	3.77	1,019
May 16	do	200	871	4.01	5.50	3,496
June 2	do	210	1,630	10.07	9.12	16,410
June 5	do	215	1,983	13.91	10.70	27,580
July 9	do	208	906	4.35	5.82	3,941
July 10	do	208	904	4.28	5.78	3,871
August 13	do	194	643	2.98	4.68	1,919
September 26	do	185	486	2.35	3.95	1,142

Daily gage height, in feet, of Grand River at Glenwood Springs, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.
1	3.34	3.29	3.36	3.68	5.95	8.55	7.32	5.05	4.35	3.88	3.95	3.25
2	3.4	3.29	3.46	3.82	6.4	9.1	6.75	4.95	4.45	3.9	3.85	3.32
3	3.34	3.26	3.48	3.88	6.42	9.2	6.58	4.85	4.32	3.98	3.88	3.25
4	3.4	3.24	3.56	3.78	6.12	9.9	6.45	4.82	4.35	3.95	3.85	3.35
5	3.44	3.24	3.61	3.72	5.85	10.7	6.15	4.72	4.32	3.92	3.98	3.38
6	3.47	3.24	3.61	3.72	5.6	10.7	6.02	4.68	4.3	3.92	4.0	3.3
7	3.47	3.24	3.64	3.78	5.45	10.4	5.95	4.65	4.35	3.92	3.98	3.18
8	3.44	3.19	3.51	3.92	5.48	10.3	5.88	4.65	4.4	3.9	3.98	3.18
9	3.42	3.19	3.44	4.1	5.8	10.72	5.85	4.58	4.32	3.85	3.92	3.15
10	3.37	3.19	3.46	4.28	6.05	10.58	5.78	4.5	4.22	3.85	3.92	3.1
11	3.32	3.19	3.48	4.48	5.88	10.48	5.7	4.5	4.22	3.85	3.88	2.9
12	3.32	3.12	3.51	4.5	5.68	10.38	5.7	4.52	4.15	3.82	3.82	3.0
13	3.22	2.96	3.56	4.48	5.58	10.02	5.7	4.7	4.12	3.85	3.8	3.1
14	3.22	2.99	3.61	4.45	5.65	9.68	5.65	4.78	4.1	3.85	3.78	3.02
15	3.32	3.04	3.66	4.5	5.62	9.68	5.65	4.62	4.05	3.85	3.85	2.95
16	3.4	3.09	3.66	4.45	5.68	9.25	5.68	4.52	4.02	3.88	3.9	3.35
17	3.37	3.14	3.71	4.32	6.0	8.85	5.58	4.42	4.0	3.9	3.88	3.4
18	3.4	3.29	3.64	4.3	6.62	8.58	5.5	4.35	4.0	3.95	3.88	3.4
19	3.47	3.24	3.66	4.45	7.1	8.25	5.5	4.32	4.02	3.95	3.88	3.38
20	3.44	3.29	3.66	4.52	7.48	7.9	5.42	4.25	4.05	3.92	3.82	3.4
21	3.4	3.29	3.64	4.58	7.68	7.8	5.28	4.22	4.1	3.82	3.78	3.4
22	3.42	3.29	3.66	4.4	7.92	7.75	5.3	4.15	4.05	3.82	3.82	3.3
23	3.42	3.26	3.66	4.4	8.4	7.78	5.28	4.12	4.02	3.95	3.78	3.25
24	3.4	3.26	3.64	4.48	8.58	7.8	5.2	4.12	4.0	3.98	3.75	3.22
25	3.4	3.32	3.61	4.6	8.45	7.78	5.12	4.15	3.98	3.95	3.65	3.2
26	3.37	3.32	3.68	4.62	8.2	7.65	5.12	4.18	3.95	3.95	3.68	3.28
27	3.37	3.34	3.68	4.62	8.2	7.65	5.02	4.15	3.92	3.95	3.68	3.32
28	3.27	3.39	3.81	4.92	8.22	7.58	5.02	4.15	3.92	3.95	3.85	3.4
29	3.24	.....	3.78	5.35	8.08	7.5	5.05	4.18	3.9	4.0	3.48	3.32
30	3.27	.....	3.68	5.52	7.85	7.42	5.02	4.18	3.95	4.02	3.12	3.22
31	3.32	.....	3.65	.....	8.0	.....	5.02	4.3	.....	3.95	.....	3.22

Station rating table for Grand River at Glenwood Springs, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.90	530	4.40	1,640	5.90	4,000	7.80	9,380
3.00	570	4.50	1,760	6.00	4,210	8.00	10,210
3.10	610	4.60	1,880	6.10	4,420	8.20	11,110
3.20	660	4.70	2,010	6.20	4,640	8.40	12,090
3.30	710	4.80	2,150	6.30	4,860	8.60	13,160
3.40	770	4.90	2,290	6.40	5,090	8.80	14,350
3.50	830	5.00	2,440	6.50	5,330	9.00	15,660
3.60	900	5.10	2,590	6.60	5,580	9.20	17,030
3.70	970	5.20	2,740	6.70	5,840	9.40	18,410
3.80	1,050	5.30	2,890	6.80	6,110	9.60	19,800
3.90	1,130	5.40	3,050	6.90	6,390	9.80	21,200
4.00	1,220	5.50	3,220	7.00	6,670	10.00	22,600
4.10	1,320	5.60	3,400	7.20	7,260	10.20	24,020
4.20	1,420	5.70	3,590	7.40	7,910	10.40	25,440
4.30	1,530	5.80	3,790	7.60	8,620	10.60	26,860

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 3.5 feet and 10.7 feet.

Estimated monthly discharge of Grand River at Glenwood Springs, Colo., for 1905.

[Drainage area, 4,523 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	812	670	753	46,300	0.166	0.19
February	764	554	672	37,320	.149	.15
March	1,058	746	906	55,710	.200	.23
April	3,256	956	1,641	97,650	.363	.40
May	13,050	3,135	6,675	410,400	1.48	1.71
June	27,710	7,980	16,590	987,200	3.67	4.10
July	7,646	2,470	3,614	222,200	.799	.92
August	2,515	1,340	1,735	106,700	.384	.44
September	1,700	1,130	1,356	80,690	.300	.33
October	1,240	1,066	1,142	70,220	.252	.29
November	1,220	620	1,067	63,490	.236	.26
December	770	530	685	42,120	.151	.17
The year	27,710	530	3,070	2,220,000	.679	9.22

GRAND RIVER NEAR PALISADES, COLO.

This station was established April 9, 1902. It is located at the steel highway bridge at the point where the river enters Grand Valley, 2 miles above Palisades, in T. 11 S., R. 98 W., and is above all irrigating ditches supplying water to Grand Valley, with the exception of one pumping plant, which takes about 20 second-feet from the river one-fourth mile above the station.

The stream channel is straight for 600 feet both above and below the station. The right bank is high and rocky, is composed largely of bowlders, cobblestones, and gravel, and will not overflow. The left bank is somewhat lower and will overflow for a short distance, but only at extreme high water. It is composed primarily of bowlders covered with sand. Above the banks are narrow mesas merging into abrupt talus slopes capped by sandstone, which rise precipitously for several hundred feet. From station 70 to station 140 the bed of the stream is approximately level and is composed of solid sandstone. Below the surface of the water on each side of this clean portion of the channel are large fragments of sandstone and large lava bowlders. During low water a deposit of silt forms to a depth of about 1 foot in the deeper portion of the channel and also fills in the large interstices of the rough banks. At high water this deposit is scoured out. The depth of the water varies from 12 feet at low stages to 22 feet at extreme high stages. This unusual depth of water at the low stage is due to the retardation of flow caused by immense sandstone bowlders and detritus across the stream channel, about 1,500 feet below the station, at a point locally called the Narrows. As a result the low-water current is sluggish and there are considerable areas of dead or backwater along each side. At high water the current is moderate at the sides, increasing very rapidly toward the center of the stream, where velocities of 20 feet per second have been observed. There is but one channel at all stages. Surface ice forms across the channel during winter.

At the recently constructed suspension bridge at Palisades the channel is straight, wide, and of uniform depth, the bed is of cobblestones, and the stream current is even. Conditions at the suspension bridge are far superior to those at the highway bridge for high-water measurements, while the reverse is true for low-water measurements.

At low water discharge measurements are made from the downstream side of the single-span steel highway bridge, which is 212 feet between masonry abutments. The initial point for soundings is the edge of the capstone of the left masonry abutment. At high

stages discharge measurements are made from the 320-foot suspension bridge at Palisades, the initial point for soundings being at the face of the left abutment.

The gage, which was observed twice daily during 1905 by S. M. Purdy, was originally of wire and was located on the downstream side near the center of the highway bridge. On April 5, 1904, the wire gage was replaced by a new chain gage. The zero of the chain gage is identical with the zero of the wire gage. The scale on the inside of the chain-gage box reads from 11.6 to 22.5 feet. The length of the chain is 21.27 feet. The bench mark is a point on the capstone on the downstream end of the approach abutment on right bank of river. It is marked with a circle cut about the point and the letters "B. M.;" elevation above the zero of the gage, 29.49 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, pp 46–47; 100, p 87; 133, p 142.
Discharge: 85, p 47; 100, p 88; 133, p 142.
Discharge, monthly: 85, p 48; 100, p 89; 133, p 144.
Gage heights: 85, p 47; 100, p 88; 133, p 143.
Rating tables: 85, p 48; 100, p 89; 133, p 143.

Discharge measurements of Grand River near Palisades, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 29[a]	R. I. Meeker	140	1,083	1.39	12.40	1,504
June 3[a]	do	222	2,767	9.00	20.25	24,900
July 11[a]	do	191	1,683	3.68	14.92	6,210
August 12[b]	do	270	774	3.49	13.30	2,699
September 27[b]	do	255	677	2.38	12.50	1,608

[a] Measured at gage. [b] Measured from suspension bridge.

Daily gage height, in feet, of Grand River near Palisades, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	12.5	15.2	19.35	17.0	14.25	12.7	12.75
2	12.5	16.1	20.05	16.75	14.05	12.8	12.7
3	12.55	16.45	20.35	16.3	13.85	12.85	12.7
4	12.55	16.05	21.0	16.0	13.7	12.8	12.7
5	12.45	15.55	22.05	15.8	13.55	12.95	12.7
6	12.4	15.15	22.0	15.5	13.6	13.05	12.55
7	12.4	15.0	21.8	15.35	13.4	12.95	12.5
8	12.4	14.9	21.35	15.2	13.4	12.9	12.5
9	12.4	15.3	22.0	15.15	13.35	12.8	12.5
10	12.95	15.6	22.0	15.0	13.25	12.8	12.5
11	13.3	15.65	21.3	14.95	13.3	12.8	12.5
12	13.7	15.3	21.25	14.95	13.3	12.7	12.5
13	13.4	15.35	20.6	14.8	13.45	12.7	12.5
14	13.3	15.45	20.35	14.75	13.4	12.6	12.5
15	13.3	15.2	20.4	14.7	13.35	12.6	12.5
16	13.3	15.3	20.4	14.7	13.25	12.55	12.55
17	13.2	15.65	19.9	14.65	13.1	12.5	12.65
18	13.2	16.45	19.45	14.55	12.95	12.5	12.7
19	13.25	17.3	19.05	14.4	12.85	12.5	12.65
20	13.35	17.85	18.7	14.75	12.8	12.5	12.6
21	13.4	18.1	18.35	14.5	12.7	12.5	12.6
22	13.35	18.85	18.15	14.35	12.7	12.5	12.6

Daily gage height, in feet, of Grand River near Palisades, Colo., for 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
23	13.3	19.45	18.2	14.3	12.6	12.5	12.75
24	13.35	19.95	18.2	14.15	12.6	12.5	12.7
25	13.5	19.8	17.95	14.0	12.7	12.7	12.7
26	13.6	19.55	18.0	13.9	12.75	12.6	12.7
27	13.75	19.5	17.95	13.85	12.7	12.5	12.7
28	13.95	19.4	17.7	13.75	12.65	12.5	12.7
29	14.35	19.0	17.4	13.7	12.65	13.0	12.7
30	14.85	18.7	17.3	13.85	12.7	12.9	12.7
31	.....	18.8	.....	13.95	12.75	.....	12.75

Station rating table for Grand River near Palisades, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
12.00	1,120	13.70	3,440	15.30	7,120	17.80	15,430
12.10	1,210	13.80	3,640	15.40	7,380	18.00	16,250
12.20	1,300	13.90	3,850	15.50	7,650	18.20	17,080
12.30	1,400	14.00	4,060	15.60	7,920	18.40	17,920
12.40	1,500	14.10	4,270	15.70	8,200	18.60	18,780
12.50	1,610	14.20	4,490	15.80	8,480	18.80	19,650
12.60	1,720	14.30	4,710	15.90	8,770	19.00	20,530
12.70	1,830	14.40	4,940	16.00	9,070	19.20	21,430
12.80	1,950	14.50	5,170	16.20	9,680	19.40	22,340
12.90	2,070	14.60	5,400	16.40	10,320	19.60	23,260
13.00	2,200	14.70	5,640	16.60	10,980	19.80	24,200
13.10	2,350	14.80	5,880	16.80	11,660	20.00	25,160
13.20	2,510	14.90	6,120	17.00	12,370	20.50	27,640
13.30	2,680	15.00	6,360	17.20	13,100	21.00	30,210
13.40	2,860	15.10	6,610	17.40	13,850	21.50	32,860
13.50	3,050	15.20	6,860	17.60	14,630	22.00	35,590
13.60	3,240						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905 and three high-water measurements of 1906. It is well defined.

Estimated monthly discharge of Grand River near Palisades, Colo., for 1905.

[Drainage area, 8,546 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	6,000	1,500	2,644	157,300	.309	.345
May	24,920	6,120	13,080	804,300	1.53	1.76
June	35,870	13,470	24,440	1,454,000	2.86	3.19
July	12,370	3,440	6,084	374,100	.712	.821
August	4,600	1,720	2,527	155,400	.296	.341
September	2,275	1,610	1,830	108,900	.214	.239
October	1,890	1,610	1,747	107,400	.204	.235
The period	.....	.....	.....	3,161,000	.....	.....

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements were made in the Grand River basin in 1905.

Miscellaneous discharge measurements made in Grand River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 9	Willow Creek	Near Hot Sulphur Springs, Colo.	42	115	5.77	[a] 3.90	664
June 28	do	do	28	30	1.67	[a] 6.20	28
July 27	East Inlet	Grand Lake, Colo.	33	47	1.64	[b] 7.30	77
August 17	do	do	21	25	.92	[b] 7.80	23
September 11	do	do	24	13	.77	[c] 8.15	10
March 28	Yampa Hot Spring.	Glenwood Springs	2.6	2.5	2.28	0.97	5.66
July 10	do	do	2.6	2.6	2.31	.99	6.00
August 13	do	do	2.6	2.9	2.21	1.10	6.40

[a] Distance to water surface from bolt in stringer of southwest corner of bridge.
[b] Distance to water surface from knot indicated in overhanging tree.
[c] U. S. B. M.

FRASER RIVER DRAINAGE BASIN.

FRASER RIVER AT GRANBY, COLO.

Fraser River rises among the peaks of the Front Range in southeastern Grand County, Colo., and flows in a general northwesterly direction to its point of junction with Grand River in the east-central part of Middle Park. The stream receives a number of small tributaries, among which are Elk, St. Louis, Crooked, and Pole creeks, all short mountain streams draining the eastern slopes of the Vasquez Mountains.

The gaging station was established July 28, 1904. It is located on the main road between Coulter and Grand Lake, at the wagon bridge three-fourths mile southwest of Granby and about 4 miles above the mouth of the river, in sec. 9, T. 1 N., R. 76 W. In the 1904 Progress Report this station was called Fraser River, near Coulter, Colo.

The channel is straight for about 100 feet above and curved for 100 feet below the station. The right bank is about 2 feet high, is covered with willows, and overflows at high stages. The left bank above the station is a high, abrupt mesa; below the station it is a 6-foot mesa for about 50 feet, then a low, brush-covered flat, which is overflowed at high stages. The bed of the stream is composed of smooth cobblestones, and the cross section is fairly uniform, clean, and permanent. There is but one channel at all stages, broken by two crib piers, which cause boiling effects and back water at high stages. The current is swift at high and medium at low water. Gage heights have a range of about 2.5 feet during an ordinary season. Ice conditions render winter gage readings impracticable.

About 40 feet below the bridge a small temporary diversion dam is placed in the stream every year for the greater part of the low-water season to divert water into an irrigation ditch on the left bank. This weir backs the water up on the gage to a considerable depth and necessitates the construction of a separate rating curve for this period.

Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached. The initial point for soundings is immediately over the inner face of the left abutment and is marked with a circle on the downstream hand rail.

The gage, which was read twice each day during 1905 by J. N. Ostrander, a civil engineer, who lives but a few hundred feet away, is a staff, spiked vertically to the downstream inner edge of the first pier from the left bank. The gage reads from 2 feet to 10.8 feet, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows:

(1) A nail in the top of the white-pine stake driven into the left bank about 30 feet south of the left end of the bridge, projecting about 6 inches above the surface of the ground, and marked "U. S. G. S. B. M.;" elevation, 13.12 feet above the zero of the gage. (2) A cross cut on the top of the foundation stone at the southeast corner of the residence of the observer. The stone is marked "U. S. B. M." on the east face; elevation, 13.09 feet above the zero of the gage.

Discharge measurements of Fraser River near Granby, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 3	W. A. Lamb	53	122	2.16	5.10	263
May 30	do	58	168	4.03	5.70	677
June 11	do	68	192	5.70	6.20	1,092
June 30	do	54	145	3.41	5.50	495
July 8	do	56	149	2.03	5.50	302
July 26	do	52	118	1.40	5.01	165
August 2	do	50	118	1.38	5.05	163
August 16	do	44	94	1.06	4.75	100
September 9 [a]	do	42	61	1.26	4.60	77
October 2 [a]	do	39	60	1.17	4.60	70

[a] Made by wading above bridge.

Daily gage height, in feet, of Fraser River at Granby, Colo., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6.1	5.45	5.1	4.7	4.6	17	5.22	6.15	5.2	4.75	4.6	4.35
2	.....	6.12	5.4	5.05	4.62	4.6	18	5.32	6.05	5.2	4.7	4.55	4.35
3	.....	6.22	5.35	5.0	4.6	4.55	19	5.42	5.9	5.15	4.65	4.55	4.3
4	.....	6.55	5.3	4.95	4.6	4.5	20	5.48	5.85	5.25	4.65	4.5	4.25
5	.....	6.65	5.25	4.9	4.7	4.5	21	5.55	5.85	5.25	4.62	4.5	4.32
6	.....	6.4	5.25	4.9	4.7	4.5	22	5.69	5.85	5.15	4.6	4.5	4.25
7	4.88	6.5	5.15	4.9	4.7	4.5	23	5.88	5.85	5.1	4.6	4.5	4.3
8	5.08	6.5	5.3	4.85	4.72	4.5	24	5.78	5.8	5.12	4.62	4.5	4.3
9	5.15	6.6	5.5	4.82	4.6	4.5	25	5.65	5.72	5.08	4.62	4.5	4.4
10	4.98	6.42	5.4	4.8	4.6	4.42	26	5.68	5.75	5.05	4.65	4.45	4.4
11	4.92	6.35	5.35	4.92	4.6	4.4	27	5.78	5.7	5.0	4.65	4.45	4.4
12	4.9	6.3	5.3	5.05	4.6	4.35	28	5.9	5.58	4.98	4.65	4.4	4.4
13	5.02	6.35	5.28	4.95	4.6	4.35	29	5.72	5.55	5.0	4.7	4.5	4.4
14	4.92	6.3	5.3	4.88	4.6	4.35	30	5.72	5.5	5.1	4.7	4.5	4.4
15	4.9	6.35	5.3	4.82	4.6	4.3	31	5.78	.....	5.1	4.65	.....	4.4
16	5.05	6.35	5.3	4.75	4.6	4.3							

Station rating table for Fraser River at Granby, Colo., from January 1 to July 8, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.90	180	5.40	431	5.90	819	6.40	1,313
5.00	218	5.50	499	6.00	910	6.50	1,422
5.10	262	5.60	572	6.10	1,005	6.60	1,533
5.20	313	5.70	649	6.20	1,104		
5.30	369	5.80	732	6.30	1,207		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined.

Station rating table for Fraser River at Granby, Colo., from July 9 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.20	26	4.60	74	5.00	154	5.40	267
4.30	35	4.70	91	5.10	179	5.50	302
4.40	46	4.80	110	5.20	206		
4.50	59	4.90	131	5.30	235		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined between gage heights 4.6 feet and 5.5 feet. This second table is necessary on account of a dam which was put in a short distance below the gage.

Estimated monthly discharge of Fraser River at Granby, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 7-31	819	172	451	22,360
June	1,590	499	1,030	61,290
July	465	149	250	15,370
August	179	74	110	6,764
September	95	46	70.1	4,171
October	74	30	47	2,890
The period				112,800

WILLIAMS FORK DRAINAGE BASIN.

WILLIAMS FORK NEAR HOT SULPHUR SPRINGS, COLO.

Williams Fork rises in the Williams River Mountains in southeastern Grand County, flows in a general northwesterly direction, and unites with Grand River in the central part of Middle Park, Colorado.

The gaging station was established July 25, 1904. It is located at the wagon bridge on the ranch of F. A. Field, in T. 1 N., R. 79 W., about 9 miles west of Hot Sulphur Springs, 4 miles above the mouth of the stream, and below all the tributaries.

The channel is straight for about 100 feet above and below the station. The right bank is a low gravel bar, lined with willows, and at extreme high stages is overflowed for a distance of 75 feet from the second channel. The left bank is a level pasture land, about 4 feet high, and is not liable to overflow. The bed of the stream is composed of small and medium-sized bowlders and is permanent. At low water there is but one channel; at high water a second channel begins about 300 feet above the bridge, on the right side of the stream, passes about 100 feet from the right end of the bridge, and enters the main stream 200 feet below. This channel is very rough and irregular and is almost entirely covered with grass and shrubbery. The current is swift at high and medium at low stages. Gage heights have a range of about 1.8 feet in an ordinary season. During the winter months ice obstructs the channel to such an extent as to make gage readings impracticable. High-water measurements are affected by the back water and boiling caused by the middle pier of the bridge and by the roughness of bed of the second channel.

Discharge measurements are made from the downstream side of the 2-span wooden bridge to which the gage is attached. The initial point for soundings is a 60-penny nail driven into the top of the left end of the downstream guard rail of the bridge, immediately over the inside face of the abutment. The second channel formed at high water is measured by wading at convenient points.

The gage, which was read twice each day during 1905 by F. A. Field, is a staff, graduated from 2 to 8 feet, fastened vertically to the downstream end of the middle crib pier, the 2-foot mark resting on the bed of the stream. The bench mark is a 60-penny nail driven into the

south face of a white-pine tree standing on the left bank of the river 30 feet north of the west end of the bridge; elevation, 6.03 feet above the zero of the gage. Elevation above sea level is about 7,600 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 146–148.

Discharge measurements of Williams Fork near Hot Sulphur Springs, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 2	W. A. Lamb	50	85	2.73	3.89	232
May 8	do	44	74	2.26	3.70	167
May 29	do	54	103	3.65	4.15	376
June 5	do	66	157	5.39	4.85	846
June 8	do	64	147	5.60	4.80	824
June 29	do	47	99	3.90	4.20	386
July 12	do	48	91	2.36	3.85	215
July 24	do	43	73	1.89	3.61	138
August 29	do	33	54	1.13	3.31	61
September 8	do	33	54	1.19	3.30	64
September 29	do	25	44	1.11	3.23	49

Daily gage height, in feet, of Williams Fork near Hot Sulphur Springs, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.19	3.84	4.39	4.18	3.58	3.33	3.32
2	3.14	3.88	4.48	4.11	3.52	3.29	3.32
3	3.12	3.80	4.55	4.09	3.51	3.32	3.30
4	3.13	3.70	4.72	4.02	3.52	3.30	3.26
5	3.18	3.62	4.82	3.98	3.50	3.31	3.22
6	3.20	3.57	4.72	3.94	3.51	3.34	3.22
7	3.24	3.63	4.82	3.90	3.50	3.34	3.22
8	3.25	3.71	4.78	3.90	3.50	3.30	3.22
9	3.32	3.74	4.89	3.89	3.48	3.29	3.22
10	3.36	3.65	4.80	3.84	3.49	3.28	3.10
11	3.34	3.62	4.68	3.84	3.50	3.28	3.18
12	3.36	3.60	4.68	3.82	3.52	3.26	3.19
13	3.40	3.71	4.74	3.80	3.50	3.26	3.24
14	3.34	3.63	4.68	3.81	3.48	3.25	3.18
15	3.28	3.60	4.70	3.80	3.46	3.22	3.18
16	3.30	3.69	4.68	3.76	3.40	3.21	3.28
17	3.30	3.84	4.65	3.71	3.40	3.26	3.24
18	3.38	3.92	4.55	3.70	3.38	3.29	3.21
19	3.44	3.98	4.52	3.76	3.39	3.36	3.16
20	3.38	4.05	4.45	3.76	3.35	3.30	3.14
21	3.32	4.05	4.46	3.72	3.34	3.30	3.14
22	3.39	4.15	4.42	3.71	3.36	3.28	3.22
23	3.39	4.22	4.40	3.64	3.38	3.28	3.27
24	3.42	4.22	4.43	3.62	3.36	3.24	3.30
25	3.42	4.18	4.34	3.61	3.31	3.24	3.24
26	3.45	4.18	4.36	3.61	3.30	3.26	3.24
27	3.56	4.25	4.28	3.62	3.28	3.26	3.24
28	3.62	4.24	4.25	3.60	3.28	3.22	3.30
29	3.66	4.12	4.21	3.58	3.37	3.22	3.22
30	3.78	4.18	4.17	3.58	3.35	3.38	3.27
31		4.31		3.58	3.36		3.30

Station rating table for Williams Fork near Hot Sulphur Springs, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	25	3.60	130	4.10	335	4.60	650
3.20	40	3.70	160	4.20	390	4.70	730
3.30	60	3.80	200	4.30	450	4.80	810
3.40	80	3.90	240	4.40	510	4.90	900
3.50	105	4.00	285	4.50	580		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905 and is well defined.

Estimated monthly discharge of Williams Fork near Hot Sulphur Springs, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	192	28	74.1	4,409
May	456	122	253	15,560
June	891	374	628	37,370
July	379	125	201	12,360
August	125	56	87.6	5,386
September	76	42	56.5	3,362
October	64	25	46.6	2,865
The period				81,310

TROUBLESOME RIVER DRAINAGE BASIN.

TROUBLESOME RIVER AT TROUBLESOME, COLO.

Troublesome River rises among the peaks of the Continental Divide in the northern part of Grand County, Colo., and flows southward to its point of junction with Grand River in Middle Park.

The gaging station was established July 22, 1904. It is located about 100 yards below the highway bridge at Troublesome, Colo., in sec. 12, T. 1 N., R. 80 W.

The channel is straight for about 50 feet above and 100 feet below the station. The right bank is about 3 feet high and is lined with a heavy growth of willows; the left bank is precipitous, is about 4 feet high, and is bordered by a level meadow; neither bank overflows. The bed of the stream is composed of small cobblestones and gravel, and is clean, uniform, and permanent. There is but one channel, broken by the piers of the bridge, which form eddies and undercurrents in a portion of the cross section. The current is very swift at high and medium at low stages. Gage heights have a range of about 2.5 feet in an ordinary season. During the winter months the channel is so obstructed by ice as to make gage readings impracticable.

Discharge measurements are ordinarily made by wading at convenient points near the gage rod. At extremely high stages they are made from the 2-span bridge about 100 yards above the gage-rod. The initial point for soundings is the west face of the stake driven into the top of the left bank, to which the gage rod is fastened.

The gage, which was read twice each day during 1905 by Mrs. Eva M. Becker, is an inclined staff, graduated from 0.8 foot to 5.8 feet, securely fastened to stakes driven into the left bank and bed of the stream. One vertical foot equals 1.525 feet on the slope. The gage is referred to bench marks as follows: (1) A 10-penny nail driven into the top of the stake on the left bank to which the gage is fastened; elevation, 5.83 feet above the zero of the gage.

(2) The center of a black cross painted on the bottom log near the southeast corner of Mrs. E. M. Becker's house, marked "U. S.+B. M.;" elevation, 16.08 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 148–150.

Discharge measurements of Troublesome River at Troublesome, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 29	W. A. Lamb	30	39	2.28	2.57	89
May 8	do	31	45	2.71	2.72	122
May 28	do	42	95	4.73	3.40	449
June 5	do	43	108	5.32	3.70	575
June 8	do	40	93	5.14	3.35	478
June 29	do	26	36	1.64	1.75	59
July 11	do	16	9.3	0.86	1.12	8
July 24	do	18	19	0.58	1.18	11
August 13	do	23	25	0.88	1.38	22
August 27	do	22	23	0.83	1.34	19
September 7	do	24	25	0.92	1.40	23
September 29	do	23	23	0.87	1.35	20

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Troublesome River at Troublesome, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.0	2.8	3.3	1.6	1.48	1.35	1.32
2	2.0	2.95	3.4	1.65	1.38	1.3	1.3
3	1.95	2.82	3.45	1.68	1.35	1.3	1.3
4	1.9	2.7	3.75	1.6	1.35	1.3	1.3
5	1.95	2.6	3.7	1.52	1.3	1.35	1.25
6	2.1	2.52	3.18	1.42	1.35	1.38	1.22
7	2.1	2.5	3.32	1.3	1.3	1.4	1.2
8	2.1	2.55	3.28	1.18	1.3	1.38	1.2
9	2.1	2.82	3.22	1.15	1.3	1.35	1.2
10	2.1	2.75	3.12	1.12	1.3	1.35	1.28
11	2.15	2.72	2.88	1.1	1.32	1.35	1.25
12	2.1	2.6	2.75	1.08	1.38	1.35	1.38
13	2.1	2.62	2.78	1.05	1.38	1.3	1.4
14	2.1	2.6	2.75	1.02	1.35	1.3	1.4
15	2.05	2.62	2.58	1.08	1.35	1.3	1.4
16	2.1	2.8	2.55	1.05	1.35	1.29	1.42
17	2.1	3.15	2.42	1.05	1.32	1.28	1.45
18	2.1	3.28	2.32	0.95	1.32	1.3	1.42
19	2.15	3.52	2.25	1.0	1.3	1.35	1.38
20	2.15	.....	2.22	1.15	1.3	1.35	1.35
21	2.1	.....	2.15	1.32	1.32	1.35	1.3
22	2.15	.....	2.18	1.25	1.35	1.35	1.35
23	2.2	.....	2.08	1.2	1.35	1.32	1.4
24	2.2	.....	1.98	1.28	1.35	1.3	1.4
25	2.3	.....	1.95	1.3	1.35	1.3	1.4
26	2.25	.....	1.9	1.42	1.35	1.35	1.4
27	2.3	.....	1.8	1.4	1.35	1.35	1.4
28	2.42	3.35	1.72	1.35	1.35	1.35	1.4
29	2.5	3.25	1.7	1.4	1.35	1.35	1.4
30	2.55	3.2	1.68	1.4	1.35	1.3	1.42
31	.....	3.08	.....	1.42	1.35	.....	1.48

Station rating table for Troublesome River at Troublesome, Colo., from January 1 to May 19, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	14	2.40	63	2.90	167	3.40	322
2.00	21	2.50	78	3.00	196	3.50	357
2.10	29	2.60	96	3.10	226	3.60	392
2.20	39	2.70	117	3.20	257		
2.30	50	2.80	141	3.30	289		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905. It is well defined between gage heights 1.9 feet and 2.7 feet.

Station rating table for Troublesome River at Troublesome, Colo., from May 20 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	5	1.80	68	2.60	229	3.40	475
1.10	7	1.90	84	2.70	255	3.50	510
1.20	10	2.00	102	2.80	282	3.60	546
1.30	15	2.10	121	2.90	311	3.70	584
1.40	22	2.20	141	3.00	342	3.80	623
1.50	31	2.30	162	3.10	374		
1.60	42	2.40	183	3.20	407		
1.70	54	2.50	205	3.30	441		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 1.1 feet and 1.8 feet, and is fairly accurate to gage height 3.8 feet.

Estimated monthly discharge of Troublesome River at Troublesome, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	87	14	35.1	2,089
May, 23 days	458	78	192	8,759
June	604	52	259	15,410
July	52	4.5	17.5	1,076
August	29	15	18.0	1,107
September	22	14	17.3	1,029
October	30	10	19.1	1,174
The period				30,640

MUDDY RIVER DRAINAGE BASIN.

MUDDY RIVER AT KREMMLING, COLO.

Muddy River rises among the high peaks in the northwestern part of Grand County, Colo., and flows southeastward to the point where it unites with Grand River.

The gaging station was established July 24, 1904. It is located at the highway bridge about one-eighth mile northwest of Kremmling, in sec. 7, T. 1 N., R. 80 W., about 2 miles above the mouth of the river. The station is below all tributaries of importance.

The channel is curved for about 100 feet above and straight for 50 feet below the station. The right bank is about 8 feet high above and 10 feet high below the station, and is clean and almost perpendicular. The left bank below the bridge is 10 feet high, slopes at an angle of about 45 degrees, and is lined with willows; above the bridge it is irregular and about 8 feet high. The stream at this point does not overflow except at extremely high stages, and then only for a short distance back from the left bank. The bed of the stream is composed of mud, with some sand and a few loose rocks washed from the riprap near the south abutment of the bridge, and is clean but shifting. There is but one channel at all stages, broken by the middle pier of the bridge, which is irregularly shaped and causes back water and undercurrents in a portion of the cross section, affecting the discharge measurements at high stages. The current is medium at high and very sluggish at low water. The shifting of the bed makes it very difficult to obtain a good rating curve. Gage heights have a range of about 6 feet during an ordinary season. In the winter months ice obstructs the channel to such an extent that gage readings are impracticable.

At high-water stages discharge measurements are made from the downstream side of the two-span highway bridge to which the gage is attached. The initial point for soundings is a 10-penny nail driven into the downstream hand rail over the north face of the left abutment. The hand rail is marked from 0 to 58 feet with nails driven at 2-foot intervals. At ordinary and low-water stages measurements are made by wading at convenient points below the station.

The gage, which was read twice each day during 1905 by C. S. McGee, is a staff attached vertically to the lower left corner of the middle pier of the bridge. The gage reads from 2 to 14 feet, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows: (1) A 60-penny spike driven horizontally into the west face of the left end of the downstream bridge stringer over the left abutment; elevation, 13.65 feet above the zero of the gage. (2) A 30-penny nail driven horizontally in the stringer at the east end of the north abutment of the bridge; elevation, 13.95 feet above the zero of the gage.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 150–151.

Discharge measurements of Muddy River at Kremmling, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
April 28	Wm. A. Lamb	42	99	1.75	6.32	173
May 8	do	41	140	1.81	6.90	254
May 27	do	49	338	1.98	9.95	669
June 7	do	48	354	1.90	10.10	671
June 15	do	49	264	1.32	8.38	349
June 26	do	52	66	1.18	6.35	78
July 11	do	14	11	1.45	4.61	16
July 24	do	11	6.6	.95	4.30	6.3
August 12	do	12	7.0	1.44	4.45	10
August 25	do	9	4.0	.72	4.10	2.9
September 7	do	10	5.2	1.21	4.25	6.3
September 29	do	10	5.6	1.02	4.25	5.7

NOTE.—Measurements made at different sections.

Daily gage height, in feet, of Muddy River at Kremmling, Colo., for 1905.

Day	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	7.35	6.9	8.9	5.55	4.7	4.1	4.4
2	7.3	7.32	9.35	5.15	4.6	4.0	4.4
3	6.82	7.5	9.5	5.15	4.6	4.05	4.4
4	6.68	7.2	10.15	5.1	4.6	4.1	4.4
5	6.35	7.05	10.0	5.0	4.6	4.1	4.4
6	6.38	6.4	9.45	5.0	4.5	4.2	4.4
7	6.3	6.45	9.55	4.7	4.5	4.2	4.4
8	6.35	6.65	9.55	4.6	4.5	4.2	4.4
9	6.25	7.3	10.1	4.6	4.5	4.2	4.4
10	6.1	7.35	10.15	4.5	4.5	4.0	4.4
11	5.9	6.9	9.45	4.5	4.55	4.0	4.3
12	5.6	6.6	8.9	4.5	4.3	4.0	4.3
13	5.25	6.7	8.65	4.5	4.25	4.0	4.3
14	5.1	6.75	8.75	4.4	4.3	4.0	4.3
15	5.0	6.65	8.4	4.3	4.3	4.0	4.3
16	5.15	7.0	8.15	4.4	4.3	4.0	4.3
17	5.18	8.1	7.95	4.4	4.2	4.0	4.3
18	5.2	8.3	7.45	4.4	4.2	4.0	4.3
19	5.25	9.15	7.3	4.35	4.2	4.0	4.4
20	5.05	9.6	7.05	4.3	4.1	4.0	4.4
21	5.02	9.5	6.9	4.3	4.1	4.0	4.4
22	4.95	9.75	6.75	4.3	4.1	4.0	4.4
23	5.1	10.1	6.65	4.3	4.1	4.0	4.4
24	5.25	10.65	6.5	4.3	4.1	3.7	4.4
25	5.18	9.85	6.35	4.3	4.1	3.7	4.4
26	5.3	9.45	6.25	4.3	4.1	4.0	4.5
27	5.38	9.35	6.1	4.3	4.1	4.0	4.5
28	5.9	9.45	6.05	4.3	4.1	4.0	4.5
29	6.25	8.9	5.95	4.85	4.1	4.2	4.5
30	6.48	8.55	5.7	4.7	4.1	4.3	4.4
31	.....	8.6	.....	4.7	4.1	.....	4.4

Station rating table for Muddy River at Kremmling, Colo., from July 25, 1904, to June 4, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.20	5	5.50	85	6.70	223	7.90	380
4.30	8	5.60	95	6.80	236	8.00	394
4.40	11	5.70	105	6.90	249	8.20	422
4.50	15	5.80	116	7.00	262	8.40	450
4.60	19	5.90	127	7.10	275	8.60	478
4.70	24	6.00	138	7.20	288	8.80	506
4.80	29	6.10	150	7.30	301	9.00	534
4.90	35	6.20	162	7.40	314	9.20	562
5.00	42	6.30	174	7.50	327	9.40	590
5.10	50	6.40	186	7.60	340	9.60	618
5.20	58	6.50	198	7.70	353	9.80	646
5.30	67	6.60	210	7.80	366	10.00	674
5.40	76						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined. Above gage height 10 feet the rating curve is a tangent, the difference being 15 per tenth.

Station rating table for Muddy River at Kremmling, Colo., from June 5 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	2	5.20	31	6.40	90	8.20	309
4.10	3	5.30	34	6.50	98	8.40	341
4.20	5	5.40	38	6.60	106	8.60	374
4.30	7	5.50	42	6.70	115	8.80	409
4.40	9	5.60	46	6.80	125	9.00	445
4.50	11	5.70	50	6.90	136	9.20	483
4.60	13	5.80	54	7.00	147	9.40	523
4.70	16	5.90	59	7.20	171	9.60	564
4.80	19	6.00	64	7.40	195	9.80	606
4.90	22	6.10	70	7.60	221	10.00	649
5.00	25	6.20	76	7.80	249	10.15	682
5.10	28	6.30	83	8.00	278		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905 and it is not well defined.

Estimated monthly discharge of Muddy River at Kremmling, Colo., for 1904.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July 25-31	8	5.6	6.9	96
August	29	5	11.4	701
September	36.4	5	14.8	881
October	19	8	13	799

Estimated monthly discharge of Muddy River at Kremmling, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	308	38	121	7,200
May	772	186	408	25,090
June	696	50	337	20,050
July	44	7	14	861
August	16	3	7.1	436
September	7	.5	2.7	161
October	11	7	8.7	535
The period				54,330

BLUE RIVER DRAINAGE BASIN.

BLUE RIVER NEAR KREMMLING, COLO.

Blue River rises among the peaks of the Continental Divide in the extreme southeastern part of Summit County, Colo., and flows in a general northwesterly direction until it joins Grand River above the point where the latter stream enters Gore Canyon.

The gaging station was established July 21, 1904. It is located at the State highway bridge on the road between Kremmling and Dillon, Colo., 17 miles from the former and 26 miles from the latter, in T. 2 S., R. 80 W., and is below all tributaries of any importance.

The channel is straight for about 400 feet above and 200 feet below the station. The banks are lined with willows and are not liable to overflow. The bed of the stream is very rough, but is clean and stable. There is but one channel at all stages, broken by the center pier of the bridge. Several large bowlders in the channel near the gaging section cause a wave and boiling motion of the water at high stages and eddies and dead water during low stages. Gage heights have a range in an ordinary season of about 2.5 feet. During the winter months ice forms in the channel to such an extent as to make gage readings impracticable.

Discharge measurements are made from the downstream side of the two-span iron bridge to which the gage is attached. The initial point for soundings is a 4-penny nail driven into the downstream guard rail at the left end of the bridge immediately over the east face of the left abutment. It is marked zero.

The gage at this station is read once each day by Mrs. Dolly Heatherly, who lives 1 mile south of the bridge. The original gage was a staff, graduated from 2 to 11 feet, fastened vertically to the west face of the middle masonry pier near the downstream end. On August 26, 1904, this gage was removed and was replaced by a regulation chain gage, the elevation of the datum of the two gages being the same. In September, 1905, the wooden gage was reset in its original position and datum and is to be used during season of high water; at all other times the chain gage is to be used. The gage is referred to bench marks as follows: (1) A cross cut in the top of the second step from the top of the downstream wing of the left abutment, painted black, and marked "U. S.+B. M."; elevation, 9.04 feet above the zero of the gage. (2) A 60-penny spike driven vertically into the west end of the block, to which the pulley of the gage is fastened; elevation, 11.69 feet above the zero of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 151–153.

Discharge measurements of Blue River near Kremmling, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec. ft.*
April 27[a]	W. A. Lamb	108	151	2.29	2.50	346
May 9	do	131	210	2.80	2.90	589
May 26	do	147	371	5.01	3.50	1,860
June 7	do	166	541	6.06	4.60	3,276
June 28	do	151	382	4.53	3.45	1,732
July 23	do	139	236	2.97	3.12	702
August 12	do	125	212	2.70	2.82	572
August 26	do	118	182	2.30	2.58	420
September 6	do	115	182	2.43	2.59	422
September 13	do	110	151	1.88	2.45	284
September 28	do	99	125	1.69	2.30	211

[a] Channel partly filled with ice along sides and piers.

Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.9	3.95	3.4	2.85	2.7	2.2	2.15	2.2
2		3.0	4.0	3.4	2.8	2.5	2.3	2.15	2.0
3		2.9	4.1	3.4	2.75	2.45	2.3	2.2	2.1
4		2.95	4.2	3.2	2.7	2.5	2.25	2.3	2.0
5	2.1	2.8	4.3	3.1	2.7	2.5	2.2	2.25	1.7
6	2.1	2.6	4.0	3.1	2.7	2.5	2.25	2.25	1.7

Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
7	2.2	2.65	4.1	3.0	2.7	2.5	2.25	2.25	2.0
8	2.2	2.8	4.15	3.0	2.7	2.5	2.25	2.2	2.2
9	2.25	2.9	4.45	3.0	2.6	2.45	2.2	2.15	2.3
10	2.3	3.0	4.0	2.9	2.6	2.3	2.2	2.1	.....
11	2.3	2.8	4.0	2.9	2.6	2.3	2.15	2.2	.....
12	2.3	2.75	3.95	2.9	2.6	2.3	2.1	2.2	.....
13	2.3	2.95	4.05	2.9	2.7	2.3	2.2	2.2	.....
14	2.35	2.8	3.95	2.8	2.6	2.3	2.2	2.2	.....
15	2.2	2.7	4.0	2.95	2.6	2.3	2.2	2.2	.....
16	2.3	2.7	3.95	2.9	2.6	2.25	2.2	2.15	.....
17	2.3	2.9	4.0	2.9	2.5	2.2	2.25	2.1	.....
18	2.35	3.05	3.75	2.8	2.5	2.25	2.25	2.15	.....
19	2.5	3.6	3.65	2.85	2.45	2.3	2.2	2.1	.....
20	2.4	3.65	3.65	2.8	2.45	2.3	2.2	2.15	.....
21	2.35	3.65	3.55	2.8	2.45	2.3	2.3	2.3	.....
22	2.4	3.55	3.5	2.85	2.4	2.3	2.25	2.2	.....
23	2.35	3.75	3.7	2.8	2.4	2.3	2.25	2.1	.....
24	2.4	3.65	3.75	2.8	2.4	2.25	2.25	2.1	.....
25	2.4	3.6	3.55	2.85	2.45	2.3	2.25	2.2	.....
26	2.4	3.5	3.65	2.9	2.5	2.3	2.3	2.1	.....
27	2.5	3.6	3.55	2.85	2.45	2.3	2.3	2.2	.....
28	2.6	3.55	3.55	2.8	2.45	2.25	2.3	2.15	.....
29	2.65	3.6	3.45	2.8	2.5	2.2	2.25	2.0	.....
30	2.8	3.65	3.4	2.8	2.5	2.2	2.2	2.0	.....
31	.....	3.7	.....	2.8	2.65	.....	2.2	.....	.....

EAGLE RIVER DRAINAGE BASIN.

EAGLE RIVER NEAR EAGLE, COLO.

Eagle River, an important headwater tributary of Grand River, rises among the high peaks of the Continental Divide, in Eagle County, Colo., immediately opposite the headwaters of Arkansas River, flows a little north of west for about 20 miles, and then in a general westerly direction to its junction with the Grand. It is a very rapid stream throughout its entire course, flowing alternately through canyons and narrow, terraced valleys.

The drainage area is almost wholly in Eagle County. The upper third of the basin is entirely mountainous, the general elevation at the crest of the divide being 12,000 feet above sea level, with peaks over 14,000 feet in altitude. In this part of its course the river descends in falls and cascades, the average slope above the mouth of Roche Moutonnée Creek being 150 feet per mile. The rocks are about equally divided between metamorphic granites and sedimentary formations. The forest cover is excellent, soil is shallow, and erosion is small. The annual precipitation, which is mostly in the form of snow, varies from 20 to 30 inches. This portion of the basin furnishes 90 per cent of the discharge of the stream.

The lower two-thirds of the basin is also mountainous but is less accentuated, the elevations varying from 7,000 to 11,000 feet. The rocks are largely sedimentary, erosion is greater, and the forest cover is meager. The precipitation is approximately 20 inches.

The principal tributaries of the Eagle are Gore, Roche Moutonnée, Gypsum, and Brush creeks.

Below Wolcott a few small ditches divert water for irrigation of the narrow first bench lands, and there is enough irrigation in Gypsum and Brush Creek valleys to divert the entire flow during the latter part of the season.

The gaging station was established March 12, 1905. It is located at Rule's private road bridge, in T. 5 S., R. 85 W., 2½ miles below Eagle, Colo. The chief object of the station is the collection of power data.

The channel is straight for 250 feet above and 150 feet below the station. The right bank is high, is composed of bowlders, cobblestones, and gravel, and does not overflow; the left bank, a long, narrow bottom bordered by abrupt mesa bluffs, overflows at high water to base of bluffs. Both banks are covered with scattered trees and brush. The bed of the stream is composed of cobblestones and bowlders and is permanent but very rough. There is but one channel at all stages. At low water there is an area of dead water at the left abutment, due to a depression in the bed of the stream under the bridge, and the current is sluggish; at high water this area of dead water disappears. The center of the current is very swift during high water. Above and below the bridge the velocity is much greater than at the bridge. The height of water ranges from 0.8 foot to 6 feet on the gage. Ice forms over the channel under the bridge during cold weather.

Discharge measurements are made from the downstream side of the 66-foot single-span wooden bridge, which stands at right angles to the stream current. The initial point for soundings is the face of the left abutment.

A vertical staff gage, which was read twice each day during 1905 by Kenneth Rule, is spiked to the face of the left abutment of the bridge. The gage is graduated from zero to 10 feet. The bench mark is a point encircled by paint and marked "B.M." on a large bowlder at the right of the bridge; elevation, 15.72 feet above the zero of the gage.

Discharge measurements of Eagle River near Eagle, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 18	R. I. Meeker	40	119	1.57	0.80	187
May 12	do	50	207	3.55	2.20	735
July 10	do	45	233	3.41	2.40	794
August 15 [a]	do	45	202	2.01	1.55	406
September 25 [a]	do	60	162	1.22	1.00	198

[a] Made from Eagle bridge.

Daily gage height, in feet, of Eagle River near Eagle, Colo., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.7	2.65	4.45	3.25	1.75	1.15	1.15	0.9	0.9
2		.8	3.0	4.7	3.05	1.7	1.05	1.15	.9	.95
3		.7	2.6	4.9	2.85	1.6	.95	1.15	1.0	.9
4		.65	2.35	5.8	2.65	1.65	1.25	1.05	.95	.8
5		.7	2.25	5.45	2.6	1.6	1.35	1.05	.95	.8
6		.7	2.0	5.35	2.6	1.6	1.35	1.05	.95	.8
7		.75	2.05	5.45	2.55	1.6	1.35	1.05	.9	.8
8		.9	2.25	5.45	2.6	1.6	1.45	1.05	.9	.9
9		1.0	2.5	5.65	2.4	1.65	1.4	1.0	.9	1.0
10		1.15	2.45	5.65	2.4	1.6	1.35	1.0	.9	1.2
11		1.15	2.25	5.15	2.35	1.7	1.3	1.0	.9	1.5
12		1.25	2.15	4.8	2.3	1.75	1.35	.95	.9	2.0
13		1.2	2.4	4.9	2.25	1.7	1.3	.95	.8	1.8
14		1.25	2.25	4.95	2.2	1.65	1.25	.9	.8	2.0
15		1.15	2.25	4.65	2.15	1.6	1.2	.9	.9	2.4
16		1.2	2.5	4.4	2.05	1.55	1.05	.95	.9	2.4
17		1.15	2.95	4.15	2.0	1.35	1.1	.95	.9	2.5

Daily gage height, in feet, of Eagle River near Eagle, Colo., for 1905—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
18	.....	1.2	3.25	4.2	1.85	1.3	1.1	0.95	0.9	2.4
19	0.8	1.4	3.55	3.9	1.85	1.15	1.1	.9	.9	2.4
20	.8	1.35	3.75	3.85	1.8	1.15	1.0	.95	.9	2.4
21	.7	1.25	3.85	3.95	1.75	1.1	1.0	.95	.9	2.4
22	.75	1.3	4.2	3.7	1.7	1.0	1.05	.9	.9	2.5
23	.7	1.3	4.5	3.8	1.7	1.0	1.0	.9	.9	2.5
24	.65	1.4	4.5	3.85	1.7	.95	1.0	.9	.9	2.6
25	.7	1.4	4.1	3.75	1.7	1.0	1.0	.9	.9	.....
26	.7	1.35	4.15	3.8	1.7	1.0	1.0	.9	.9	.....
27	.78	1.5	4.25	3.7	1.65	1.05	1.0	.95	.9	.....
28	.7	1.75	4.2	3.7	1.75	1.05	1.0	1.0	.9	.....
29	.65	2.2	3.9	3.45	1.8	1.15	1.15	1.0	.9	.....
30	.7	2.35	3.9	3.4	1.7	1.25	1.2	1.1	.9	.....
31	.7	.....	4.4	.....	1.7	1.3	.....	1.1	.....	.....

GUNNISON RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Gunnison River is formed in Gunnison County, Colo., by the union of East and Taylor rivers, two streams that have their origin among the snow-covered peaks and on the slopes of the Continental Divide in the northeastern part of the county and which descend through narrow mountain valleys and unite about 12 miles above Gunnison. From the junction of these rivers the Gunnison flows west and southwest to the point where it enters Grand River at Grand Junction, in the central part of Mesa County, Colo.

The upper course of the river lies through a broad, mountainous valley, but near the mouth of Lake Fork the valley narrows and the river enters the Black Canyon of the Gunnison, through which it winds in a tortuous course for 56 miles between granite walls that rise precipitously 3,000 feet above the water's edge. A short distance below the mouth of North Fork, the largest tributary of the river, the canyon walls break abruptly, and the valley is broad and fertile. Below Delta the river enters another narrow canyon, with walls averaging 800 feet in height, and this continues irregularly to Grand Junction, a few tracts of narrow bottom land lying between the channel and the canyon walls.

As an aid to description the basin may be divided into an upper, mountainous area and a lower, plateau area, the two being divided roughly by a north-south line drawn through the town of Hotchkiss.

The mountainous portion of the basin is the greater in area and varies in altitude from 6,000 to 14,000 feet. The geologic formations include large areas of igneous as well as sedimentary rocks, the soil cover is shallow, and large tracts are entirely barren. In the more inaccessible parts of the region the primeval forest still exists, but at many places, especially in the neighborhood of the mining camps, the timber has all been cut off. The prevailing forests are spruce, aspen, cedar, and characteristic mountain undergrowth. All the arable land in the high mountain valleys is devoted to forage crops, and a number of small ditches divert water for their irrigation. Power development of considerable magnitude is feasible in this part of the basin.

The plateau region embraces the Uncompahgre Plateau along the southwestern border of the basin, the Vernal and Inclinado mesas in the central part, and the Grand Mesa in the northern part. These plateaus have an extreme elevation of 10,000 feet above sea level and break down in a series of broad steps to the valleys, with parallel drainage lines cutting deeply at right angles through these steps. The topography is the product of erosion acting on sedimentary formations. The soil of the lower valleys is chiefly adobe, and the higher

mesas have large content of gravel and sand. Groves of quaking aspen, interspersed with large, open grazing plots, cover broad areas of this plateau region. Forests of pine and aspen occur on the top of the Grand Mesa, with pinon pines and cedars along the foothills. In the valleys chico and sagebrush form the controlling vegetation, except along the streams, which are bordered to some extent by cottonwood, willow, and undergrowth.

The chief tributaries of the Gunnison are Ohio, Tomichi, Lake Fork, and Cimarron creeks and Smith, North Fork, and Uncompahgre rivers, the North Fork being the largest.

North Fork River rises in the Huntsman Hills, 20 miles south of Glenwood Springs, flows in a general south and southwesterly course, and unites with the Gunnison about 8 miles west of Hotchkiss. The drainage area is highly mountainous, except for a small portion which lies below Paonia, extreme points reaching an altitude of 13,000 feet. The mesa lands at the lower end of the valley stand 5,500 feet above sea level. The higher peaks are formed of granitic rocks, but lower down Cretaceous formations occupy at least 80 per cent of the area of the basin. The mountains are forested and the mesa lands are covered with sagebrush. All the tillable lands of the North Fork and its tributaries have been brought under cultivation, and irrigation is practiced to such an extent that the entire flow is needed for existing systems.

Uncompahgre River, the principal tributary of the Gunnison from the south, rises among the snowy peaks of the highly serrated Uncompahgre Mountains and flows a little west of north to its junction with the Gunnison at Delta. The basin embraces a mountainous, plateau, and valley area of 1,130 square miles, oblong in shape, the width increasing slightly at the lower end. The mountain area occupies but a small part of the basin, but contributes the perennial waters of the stream. The plateau area is greatest in extent and borders the valley on both sides, the larger Uncompahgre Plateau lying to the southwest. Escarpments are conspicuous features of this plateau. The relief features are terraced mesas flanked by shale buttes and ridges, trenched by deep, narrow canyons. Uncompahgre Valley proper begins at a point near Eldredge Siding, on the Denver and Rio Grande Railroad.

The other tributaries of the Gunnison need not here be described. Ohio, Tomichi, Lake Fork, and Cimarron creeks are perennial streams, but almost their entire volume is diverted for irrigation during the growing season, so that very little of their water reaches the Gunnison except at times of heavy storms or during spring floods.

Precipitation records for the Gunnison basin are meager. Those which exist show a range from 9 inches in the plateau region to about 25 inches in the mountains.

The natural flow of the Uncompahgre and North Fork rivers is diverted for irrigation along their respective valleys, and the Gunnison tunnel will divert water from the mountainous area and transmit it to the Uncompahgre Valley, which has been an irrigated district since the early eighties.

EAST RIVER AT ALMONT, COLO.

East River rises in the Elk Mountains in the northern part of Gunnison County, Colo., flows in a general southerly direction, and unites with Taylor River to form the Gunnison.

The gaging station was established April 17, 1905. It is located at the county highway bridge at Almont, 100 feet above Taylor River, in T. 51 N., R. 85 W. The object of the station is the determination of the amount of flood waters available for storage in connection with the Uncompahgre Valley project and the collection of power data.

The channel section measures 75 feet between the bridge abutments and is straight for 100 feet both above and below the station. The banks are low and are liable to overflow at extreme high water. The bed of the stream is composed of bowlders and cobblestones and is very rough but generally permanent. There are two channels at all stages, divided by the center pier of the bridge, and the current is swift. Gage heights range from 0.7 foot to 5 feet.

Discharge measurements are made from the downstream side of the two-span wooden bridge. The initial point for soundings is the face of the left abutment and is indicated by a brass-headed tack in the hand rail, marked with a circle.

The gage, which was read during 1905 by Vernon Davis, is a vertical staff graduated from zero to 7 feet, spiked to the right end of the pier on the downstream side of the bridge. The bench mark is a point on a large stump in Cottage Grove on the right bank of the river, about 25 feet from the bridge, encircled by black paint and marked "B. M.;" elevation, 6.51 feet above the zero of the gage.

Discharge measurements of East River at Almont, Colo., in 1904 and 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec-ft.*
June 14	R. I. Meeker	73	182	6.62	2.60	1,205
July 19	do	73	112	3.30	1.65	370
August 16	do	73	105	3.01	1.55	316
September 23	do	72	76	2.00	1.15	152
1905.						
April 15	do	58	75	2.53	0.80	190
May 26	A. A. Weiland	73	256	7.62	2.90	1,951
June 17	do	73	237	7.89	3.10	1,869
July 6	do	71	153	5.08	2.10	777
August 10	do	64	94	2.86	1.50	269
August 29	do	51	75	2.28	1.30	171

NOTE.—The 1904 measurements were made before the station was established. The gage heights were obtained from reference points.

Daily gage height, in feet, of East River at Almont, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		1.75	3.25	2.35	1.9	1.3	1.0
2		1.8	3.6	2.35	1.8	1.2	.9
3		1.7	4.35	2.3	1.7	1.2	.9
4		1.45	4.7	2.25	1.7	1.2	.9
5		1.4	4.55	2.15	1.7	1.2	.9
6		1.3	4.0	2.2	1.7	1.2	.9
7		1.3	3.85	2.0	1.7	1.3	.9
8		1.4	4.4	2.0	1.6	1.2	.9
9		1.55	4.75	1.95	1.5	1.2	
10		1.45	4.15	1.85	1.5	1.2	
11		1.45	3.85	1.85	1.5	1.2	
12		1.4	3.55	1.85	1.5	1.2	
13		1.5	3.65	1.85	1.5	1.2	
14		1.5	3.55	1.85	1.4	1.2	
15		1.45	3.55	1.85	1.4	1.2	
16	0.8	1.7	3.35	1.85	1.4	1.1	
17	.75	1.9	2.95	1.85	1.4	1.1	
18	.8	2.05	2.9	1.85	1.4	1.1	
19	.9	2.45	2.7	1.8	1.4	1.1	
20	.85	2.6	2.4	1.7	1.4	1.0	
21	.8	2.75	2.55	1.8	1.4	1.0	
22	.9	2.85	2.4	1.7	1.4	1.0	
23	.85	3.3	2.5	1.7	1.4	1.0	
24	.85	3.15	2.6	1.7	1.5	1.0	
25	1.05	2.85	2.5	1.75	1.5	1.0	
26	1.0	3.1	2.45	1.7	1.4	1.0	
27	1.1	3.0	2.4	1.75	1.4	1.0	
28	1.2	2.75	2.4	1.7	1.4	1.0	
29	1.45	2.55	2.4	1.7	1.4	1.0	
30	1.65	2.5	2.35	1.8	1.4	1.0	
31		2.85		2.1	1.4		

Station rating table for East River at Almont, Colo., from April 16 to June 1, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	190	1.50	420	2.20	850	2.90	1,610
0.90	210	1.60	470	2.30	940	3.00	1,750
1.00	240	1.70	520	2.40	1,030	3.10	1,900
1.10	270	1.80	580	2.50	1,130	3.20	2,060
1.20	300	1.90	640	2.60	1,240	3.30	2,220
1.30	340	2.00	700	2.70	1,360		
1.40	380	2.10	770	2.80	1,480		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is not well defined. Estimates based on this table are rough approximations.

Station rating table for East River at Almont, Colo., from June 2 to October 8, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	80	2.00	610	3.00	1,750	4.00	3,430
1.10	110	2.10	700	3.10	1,900	4.10	3,620
1.20	140	2.20	790	3.20	2,050	4.20	3,810
1.30	180	2.30	890	3.30	2,210	4.30	4,000
1.40	220	2.40	990	3.40	2,370	4.40	4,190
1.50	270	2.50	1,100	3.50	2,540	4.50	4,380
1.60	330	2.60	1,220	3.60	2,710	4.60	4,570
1.70	390	2.70	1,340	3.70	2,890	4.70	4,770
1.80	460	2.80	1,470	3.80	3,070	4.80	4,970
1.90	530	2.90	1,610	3.90	3,250		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905, and is well defined between gage heights 1.3 feet and 3.1 feet.

Estimated monthly discharge of East River at Almont, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 16–30	495	180	249	7,408
May	2,220	340	910	55,950
June	4,870	940	2,329	138,600
July	940	390	537	33,020
August	530	220	280	17,220
September	180	80	117	6,962
October 1–8	80	60	62.5	992
The period				260,200

TAYLOR RIVER NEAR ALMONT, COLO.

Taylor River rises in northeastern Gunnison County, Colo., among the high peaks of the Continental Divide, flows in a general southwesterly direction, and unites with East River to form the Gunnison.

The gaging station was established April 17, 1905. It is located at George Clark's private road bridge, 14 miles above Almont, Colo., in T. 15 S., R. 83 W. The object of the station

is the determination of the amount of flood water available for storage in connection with the Uncompahgre Valley project, and the collection of power data.

The channel is straight for several hundred feet both above and below the station. The banks are both low, composed of bowlders and earth, are partly lined with willows, and are not liable to overflow. The stream bed is made up of large bowlders and cobblestones, and is very rough but permanent. The fall is large, the slope being equal to 0.016, or about 80 feet per mile. The crib piers of the bridge divide the channel into three parts. The velocity is rapid at all stages. Ice conditions interfere with measurements during the winter months. Accurate measurements are exceedingly hard to obtain on account of the roughness of the channel.

Discharge measurements are made from the downstream side of a pole bridge, which is 75 feet between abutments and is supported by two crib piers. The gage, which was read during 1905 by George Clark, is a vertical staff, graduated from zero to 7 feet, spiked to the left side of the left pier. The bench mark is a point, encircled with white paint and marked "B. M.," on top of a granite bowlder on the left bank just below the bridge; elevation above the zero of the gage, 4.34 feet.

Discharge measurements of Taylor River near Almont, Colo., in 1904 and 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 15	R. I. Meeker	58	142	5.61	2.22	796
July 18	do	58	101	3.27	1.47	330
August 17	do	58	104	3.88	1.77	404
September 21	do	58	69	2.33	1.12	161
1905.						
April 17	R. I. Meeker	44	64	1.78	1.00	114
May 26	A. A. Weiland	58	173	5.76	2.60	996
June 17	do	58	174	5.86	2.60	1,044
July 6	do	58	130	3.32	1.70	432
August 10	do	58	100	2.27	1.20	227
August 29	do	58	99	2.03	1.10	201

NOTE.—The 1904 measurements were made before the station was established. The gage heights were obtained from reference points.

Daily gage height, in feet, of Taylor River near Almont, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		2.1	3.4	1.9	1.45	1.1	1.1	1.0
2		1.8	3.55	1.85	1.35	1.1	1.1	1.0
3		1.35	3.75	1.75	1.4	1.1	1.1	1.0
4		1.3	4.15	1.75	1.4	1.1	1.1	1.0
5		1.25	4.25	1.7	1.35	1.1	1.1	1.0
6		1.25	3.85	1.75	1.35	1.1	1.1	1.0
7		1.15	3.8	1.65	1.3	1.1	1.1	1.0
8		1.75	4.2	1.65	1.25	1.1	1.1	1.0
9		1.55	4.4	1.6	1.2	1.1	1.1	1.0
10		1.4	3.7	1.6	1.2	1.1	1.0	1.0
11		1.4	3.4	1.55	1.25	1.1	1.0	1.0
12		1.4	3.4	1.55	1.3	1.1	1.0	1.0
13		1.45	3.6	1.55	1.25	1.1	1.0	1.0
14		1.5	3.4	1.55	1.2	1.1	1.0	1.0
15		1.6	3.4	1.55	1.2	1.1	1.0	1.0
16		1.8	3.1	1.55	1.2	1.1	1.0	1.0

Daily gage height, in feet, of Taylor River near Almont, Colo., for 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
17	1.0	1.85	2.8	1.55	1.2	1.1	1.0	0.95
18	1.05	2.15	2.7	1.45	1.15	1.1	1.0	.85
19	1.1	2.3	2.5	1.45	1.1	1.1	1.0	.8
20	1.1	2.4	2.6	1.45	1.1	1.1	1.0	.7
21	1.1	2.6	2.45	1.45	1.1	1.1	1.0	.7
22	1.1	2.7	2.4	1.45	1.1	1.1	1.0	.65
23	1.1	2.95	2.45	1.35	1.1	1.1	1.0	.5
24	1.15	2.95	2.4	1.35	1.1	1.1	1.0	.4
25	1.2	2.9	2.4	1.35	1.1	1.1	1.0	.....
26	1.2	2.8	2.4	1.35	1.1	1.1	1.0	.....
27	1.4	2.55	2.25	1.35	1.1	1.1	1.0	.....
28	1.8	2.4	2.2	1.35	1.1	1.1	1.0	.....
29	1.95	2.3	2.15	1.35	1.1	1.1	1.0	.....
30	2.05	2.3	2.15	1.35	1.1	1.1	1.0	.....
31	.....	3.0	.....	1.45	1.1	.....	1.0	.....

Station rating table for Taylor River near Almont, Colo., from April 17 to May 26, 1905

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	115	1.60	365	2.20	725	2.80	1,190
1.10	150	1.70	420	2.30	795	2.90	1,280
1.20	185	1.80	475	2.40	870	3.00	1,370
1.30	225	1.90	535	2.50	945		
1.40	270	2.00	595	2.60	1,025		
1.50	315	2.10	660	2.70	1,105		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined.

Station rating table for Taylor River near Almont, Colo., from May 27 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	70	1.30	255	2.20	725	3.20	1,555
.50	85	1.40	290	2.30	795	3.40	1,750
.60	100	1.50	330	2.40	870	3.60	1,950
.70	115	1.60	375	2.50	945	3.80	2,160
.80	135	1.70	425	2.60	1,025	4.00	2,370
.90	155	1.80	480	2.70	1,105	4.20	2,580
1.00	175	1.90	535	2.80	1,190	4.40	2,790
1.10	200	2.00	595	2.90	1,280		
1.20	225	2.10	660	3.00	1,370		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1 foot and 2.6 feet.

Estimated monthly discharge of Taylor River near Almont, Colo., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 17 to 30	628	115	248	6,887
May	1,370	168	650	39,970
June	2,790	692	1,518	90,330
July	535	272	351	21,580
August	310	200	182	11,190
September	200	200	200	11,900
October	200	175	121	7,440
November 1 to 24	175	70	156	7,426
The period				196,700

GUNNISON RIVER NEAR CIMARRON, COLO.

This station was established September 18, 1903. It is located at the Denver and Rio Grande Railroad bridge, 1½ miles from Cimarron, Colo., 1,000 feet above the mouth of Cimarron River, in T. 19 S., R. 91 W. The purpose of the station was the collection of hydrographic data relative to the Uncompahgre Valley project, which comtemplates the diversion of 1,300 cubic feet of water per second from Gunnison River about 12 miles below. The station was discontinued December 16, 1905, having been replaced by the station established at the east portal of Gunnison tunnel in April, 1905.

The channel is straight for 1,000 feet above and 300 feet below the station. The left bank is a granite cliff which rises vertically from the water. The right bank is a mountain slope of about 45°. The bed of the stream, which is permanent, is composed of granite bowlders along the sides with an even deposit of small cobblestones in the center. There is but one channel at all stages. At the cable section the left bank is an offset in the stream channel filled with a deposit of mud. The velocity is swift at low stages and very rapid during high water. Gage heights range from 3 to 12 feet.

Discharge measurements are made by means of a cable, car, stay, and tag lines. The initial point for soundings is at the face of the left cliff, 20 feet from the eye bolt to which cable is fastened, and is marked zero on the tag line.

A standard chain gage, which was read twice daily during 1905 by G. C. Gates, is installed on the upstream side of the Denver and Rio Grande Railroad bridge near the west end, about 75 feet downstream from the cable. The gage scale reads from zero to 10 feet, with two markers, giving a range of 20 feet in gage heights. The length of chain from end of weight to center of first marker is 56.06 feet. The bench mark is the top of the southeast corner capstone of the east masonry abutment of the Denver and Rio Grande Railroad bridge, a line being cut across the corner of the capstone to indicate the bench mark; elevation, 56.52 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 80–81; 133, p 157.
Discharge: 100, p 81; 133, p 157.
Discharge, monthly: 100, p 82; 133, p 159.
Gage heights: 100, p 81; 133, p 158.
Rating table: 100, p 82; 133, p 158.

Discharge measurements of Gunnison River near Cimarron, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 1	R. I. Meeker	90	235	2.71	4.30	636
May 23	A. A. Weiland	115	1,420	6.84	14.50	9,719
June 6	do	110	1,612	7.37	16.50	11,880
June 18	do	110	1,249	6.01	13.20	7,506
July 1	do	100	768	4.86	9.40	3,736
July 19	do	95	436	3.47	6.50	1,513
August 11	do	85	362	3.35	5.90	1,214
October 4	R. I. Meeker	78	239	2.44	4.40	583
October 5	do	78	232	2.23	4.30	517

Daily gage height, in feet, of Gunnison River near Cimarron, Colo., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.35	10.05	14.85	9.4	8.25	4.75	4.9	4.45	3.45
2	.....	4.45	10.15	15.6	8.95	7.35	4.7	4.55	4.05	3.25
3	.....	4.5	9.65	16.05	8.45	7.15	4.45	4.55	4.1	3.5
4	.....	4.45	8.25	17.15	7.55	7.0	4.55	4.4	4.15	3.95
5	.....	4.1	7.75	17.9	7.95	6.7	4.7	4.3	4.35	3.6
6	.....	4.25	7.55	16.6	7.8	6.45	4.75	4.25	4.25	3.75
7	.....	4.5	8.35	16.2	7.6	6.5	4.75	4.2	4.15	3.85
8	.....	4.8	8.5	16.9	7.5	6.35	4.7	4.1	4.1	3.85
9	.....	4.85	9.2	17.3	7.35	5.85	4.65	4.05	4.2	3.7
10	4.85	5.8	8.75	16.5	7.15	5.75	4.6	4.1	3.95	3.8
11	4.75	5.8	8.15	15.35	7.05	5.9	4.5	4.15	4.0	3.9
12	4.65	5.8	7.85	15.2	6.65	5.85	4.4	4.15	4.0	3.75
13	4.8	5.65	8.0	14.85	6.5	5.8	4.35	4.15	3.75	4.05
14	4.75	5.5	8.2	14.8	6.65	5.65	4.2	4.15	3.7	4.1
15	4.85	5.65	8.7	14.8	6.6	5.5	4.15	4.05	4.0	3.95
16	5.2	5.45	9.25	14.35	6.75	5.4	4.25	4.15	3.95	4.1
17	5.15	5.5	10.92	14.3	6.65	5.2	4.2	4.35	4.0	3.8
18	5.2	5.55	11.45	13.2	6.6	5.0	4.1	4.25	4.05	.....
19	5.0	5.9	12.5	12.55	6.5	4.95	4.1	4.05	4.0	.....
20	5.05	5.9	13.0	12.25	6.5	4.75	4.15	3.95	3.9	.....
21	4.7	5.65	13.25	12.2	6.55	4.55	4.2	4.1	4.1	.....
22	4.85	5.55	13.9	12.0	6.55	4.75	4.2	4.05	4.05	.....
23	4.45	5.75	14.6	11.45	6.35	4.8	4.1	4.3	4.15	.....
24	4.3	5.75	14.7	11.35	6.35	4.8	4.15	4.5	3.85	.....
25	4.3	5.9	14.2	11.3	6.2	5.05	4.2	4.25	3.7	.....
26	4.45	6.1	14.4	11.15	6.15	5.05	4.25	4.25	3.55	.....
27	4.5	6.55	14.8	11.1	6.05	5.0	4.3	4.25	4.35	.....
28	4.55	6.7	14.55	10.8	6.15	4.7	4.2	4.35	3.85	.....
29	4.25	8.3	12.5	10.6	6.65	4.9	4.15	4.2	3.4	.....
30	4.35	9.5	12.15	10.15	7.15	5.0	4.45	4.25	3.35	.....
31	4.3	.....	13.15	.....	7.9	5.0	.....	4.3	.....	.....

Station rating table for Gunnison River near Cimarron, Colo., from March 10 to December 17, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	300	5.00	775	6.80	1,660	10.20	4,535
3.30	320	5.10	815	6.90	1,725	10.40	4,750
3.40	340	5.20	855	7.00	1,790	10.60	4,970
3.50	360	5.30	895	7.20	1,925	10.80	5,190
3.60	380	5.40	940	7.40	2,065	11.00	5,410
3.70	400	5.50	985	7.60	2,215	11.50	5,960
3.80	425	5.60	1,030	7.80	2,365	12.00	6,535
3.90	450	5.70	1,075	8.00	2,520	12.50	7,110
4.00	475	5.80	1,120	8.20	2,680	13.00	7,685
4.10	500	5.90	1,165	8.40	2,840	13.50	8,260
4.20	526	6.00	1,215	8.60	3,000	14.00	8,860
4.30	553	6.10	1,265	8.80	3,180	14.50	9,460
4.40	580	6.20	1,315	9.00	3,360	15.00	10,060
4.50	610	6.30	1,370	9.20	3,540	15.50	10,660
4.60	640	6.40	1,425	9.40	3,725	16.00	11,260
4.70	670	6.50	1,480	9.60	3,915	16.50	11,860
4.80	705	6.60	1,540	9.80	4,115		
4.90	740	6.70	1,600	10.00	4,325		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is fairly well defined between gage heights 4 feet and 9.4 feet. The table has been extended beyond these limits. Above gage height 16.5 feet the rating curve is a tangent, the difference being 125 per tenth.

Estimated monthly discharge of Gunnison River near Cimarron, Colo., for 1905.

[Drainage area, 3,844 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 10-31	855	540	676	29,500	0.176	0.144
April	3,820	500	1,118	66,520	.291	.325
May	9,820	2,178	5,511	338,900	1.43	1.65
June	13,610	4,482	8,867	527,600	2.31	2.56
July	3,725	1,240	1,863	114,600	.485	.559
August	2,720	625	1,101	67,700	.286	.330
September	688	500	576	34,270	.150	.167
October	740	462	540	33,200	.140	.161
November	595	330	472	28,090	.123	.137
December 1-17	500	310	424	14,300	.110	.070
The period				1,255,000		

GUNNISON RIVER AT EAST PORTAL OF GUNNISON TUNNEL, COLORADO.

This station was established April 1, 1905, and replaces the Cimarron station, 12 miles above. It is located about 100 yards above the portal of the tunnel and is in T. 49 N., R. 7 W., 21 miles by wagon road from Montrose. The object of the station is to determine the volume of flow of the river at this point, as 1,300 second-feet will be diverted by the Gunnison tunnel when it is completed.

The channel is straight for 500 feet above and 300 feet below the station. The banks are steep, rocky mountain sides, and do not overflow. The bed of the stream is composed primarily of solid ledges of schists with a shifting deposit of gravel and sand which reaches a depth of 3 to 4 feet at low water. There is but one channel at all stages. The current is sluggish at low water, but becomes swift during high water. Gage heights range from 5 to 14 feet.

Discharge measurements are made by means of a cable, car, and tag line. The initial point for soundings is the left bank at high-water mark and is indicated by zero on tag line.

The gage, which is read twice daily by H. L. Daniels, is a vertical staff, graduated from zero to 15 feet, bolted to a vertical cliff on the right bank of the river 50 feet upstream from the cable. The bench mark is a United States Geological Survey standard aluminum tablet set in a rock ledge 50 feet south of the mouth of Gunnison tunnel; elevation of bench mark above the zero of the gage, 29.11 feet.

Discharge measurements of Gunnison River at east portal of Gunnison tunnel, Colorado, in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Sq. ft.	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 1	O. McDermith	1,301	3.48	9.05	4,529
May 27	do	1,793	4.76	11.80	8,540
June 3	do	2,105	5.32	12.80	11,200
June 17	do	1,758	4.04	11.25	7,100
June 20	do	1,649	4.06	10.60	6,690
June 29	do	1,410	3.04	9.25	4,184
July 6	do	1,166	2.17	7.60	2,525
July 13	do	1,054	1.61	6.85	1,695
August 3	do	1,091	1.87	7.12	2,044
August 11	do	917	1.12	6.00	1,025
August 19	do	860	.89	5.60	763
August 28	do	846	.81	5.50	689
September 13	do	806	.71	5.24	575

Daily gage height, in feet, of Gunnison River at east portal of Gunnison tunnel, Colorado, for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	8.95	11.95	8.75	7.85	5.5	5.55	5.3	5.2
2	.....	9.05	12.55	8.45	7.4	5.5	5.35	5.3	5.4
3	.....	8.65	12.85	8.15	7.15	5.4	5.3	5.3	5.6
4	.....	8.1	13.35	8.0	7.05	5.5	5.3	5.3	5.6
5	.....	7.8	13.95	7.85	6.85	5.5	5.25	5.3	5.6
6	.....	7.6	13.15	7.65	6.75	5.6	5.2	5.3	5.6
7	.....	7.6	12.9	7.6	6.65	5.6	5.2	5.25	5.7
8	.....	7.9	13.1	7.6	6.4	5.5	5.2	5.2	6.0
9	5.9	8.4	13.65	7.45	6.2	5.5	5.2	5.2	6.0
10	6.05	8.75	13.05	7.25	6.2	5.45	5.15	5.2	6.0
11	6.2	7.95	12.55	7.05	6.15	5.35	5.1	5.2	6.0
12	6.25	7.8	12.25	7.0	6.05	5.3	5.1	5.1	6.0
13	6.1	8.0	12.1	6.85	6.0	5.25	5.1	5.1	6.0
14	6.15	7.9	11.9	6.8	6.0	5.2	5.1	5.0	6.0
15	6.0	8.05	11.9	6.8	6.0	5.2	5.1	5.1	6.0
16	e6.1	8.48	11.75	6.8	5.85	5.2	5.1	5.05	6.0
17	6.18	9.5	11.2	6.8	5.8	5.15	5.2	5.1	6.1

Daily gage height, in feet, of Gunnison River at east portal of Gunnison tunnel, Colorado, in 1905—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
18	6.28	9.9	10.95	6.8	5.7	5.1	5.2	5.2	6.5
19	6.42	10.5	10.65	6.7	5.6	5.1	5.2	5.15	6.5
20	6.38	10.85	10.6	6.6	5.6	5.2	5.2	5.0	6.5
21	6.2	11.15	10.5	6.6	5.5	5.2	5.2	5.1	6.6
22	6.15	11.45	10.15	6.6	5.5	5.1	5.2	5.15	6.6
23	6.2	11.95	9.95	6.6	5.5	5.1	5.2	5.2	6.5
24	6.3	11.9	9.85	6.6	5.5	5.1	5.25	5.1	6.3
25	6.4	11.7	9.8	6.5	5.65	5.1	5.2	5.1	6.3
26	6.55	11.75	9.75	6.5	5.65	5.2	5.3	5.1	6.3
27	6.82	11.75	9.65	6.65	5.5	5.1	5.3	5.2	6.3
28	7.28	11.5	9.6	6.5	5.5	5.2	5.3	5.2	6.3
29	7.8	10.75	9.35	6.5	5.7	5.2	5.3	5.2	6.3
30	8.35	10.8	9.05	6.9	5.65	5.4	5.3	5.2	6.3
31	.....	10.9	.....	7.8	5.6	.....	5.3	.....	6.3

GUNNISON RIVER NEAR CORY, COLO.

This station was established April 30, 1903, It is located at the wooden highway bridge on the road between Delta and Cory, Colo., about 6 miles east of Delta.

The channel is over 200 feet wide and is straight for 300 feet above and 500 feet below the station. The right bank is abrupt, high, and wooded, and does not overflow; the left bank is a gradual slope of cobblestones, gravel, and sand to the annual flood plain; is partly covered with trees and underbrush, and overflows at extreme high water. The bed of the stream is composed of bowlders and cobblestones and is permanent. There is but one channel at all stages. The current is swift at high water. Gage heights range from 5 to 13 feet.

Discharge measurements are made from the downstream side of the two-span bridge. The initial point for soundings is a brass tack in the hand rail at the center of the left pier, downstream side of bridge.

A standard chain gage, which was read twice daily during 1905 by John Shea, is located on the downstream side of the bridge 90 feet from the right bank. The gage scale reads from zero to 10 feet, with two markers, allowing for a range of 20 feet in gage heights, the second marker being used above 10 feet. The length of the chain from the end of the weight to the center of the second marker is 14.12 feet. The bench mark is the top edge of the iron rim of the northwest cylinder pier, downstream side of bridge, marked with white paint at the point of B. M.; elevation above the datum of the gage, 17.59 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 76; 133, p 159.
Discharge: 100, pp 76, 93; 133, p 160.
Discharge, monthly: 100, p 78; 133, p 161.
Gage heights: 100, p 77; 133, p 160.
Rating table: 100, p 77; 133, p 161.

Discharge measurements of Gunnison River near Cory, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 10	R. I. Meeker	188	760	2.70	6.85	2,052
May 6	Oro McDermith	213	1,090	4.03	8.20	4,388
May 19	A. A. Welland	256	1,682	7.88	10.95	13,280
May 21	R. I. Meeker	260	1,785	8.11	11.35	14,480
May 21	A. A. Welland	260	1,785	8.04	11.25	14,350
May 31	do	256	1,688	7.64	10.95	12,890
June 3	do	269	2,056	8.86	12.20	18,220
June 13	do	266	1,893	8.38	11.80	15,860
June 27	do	232	1,329	5.57	9.45	7,405
July 11	do	200	852	3.09	7.30	2,632
August 1	do	210	942	3.46	7.70	3,263
October 2	R. I. Meeker	180	566	1.54	5.90	870

Daily gage height, in feet, of Gunnison River near Cory, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov	Dec
1	5.25	5.5	5.6	6.0	9.8	11.75	8.75	7.6	5.8	5.8	5.7	5.35
2	5.3	5.5	5.8	6.0	10.2	12.15	8.55	7.35	5.85	5.8	5.75	5.3
3	5.3	5.5	5.8	6.0	9.5	12.2	8.4	7.05	5.85	5.8	5.7	5.3
4	5.4	5.5	5.85	6.0	8.9	12.7	8.25	7.0	5.95	5.7	5.7	5.3
5	5.45	5.5	5.85	5.9	8.5	13.1	7.95	6.9	5.8	5.7	5.7	5.4
6	5.45	5.4	5.9	5.9	8.25	12.7	7.9	6.75	5.8	5.7	5.6	5.4
7	5.45	5.5	6.0	5.9	8.4	12.35	7.8	6.55	5.8	5.7	5.6	5.4
8	5.4	5.4	6.0	6.2	8.55	12.8	7.65	6.5	5.85	5.7	5.6	5.45
9	5.3	5.5	5.9	6.65	9.3	12.85	7.55	6.45	5.8	5.7	5.6	5.4
10	5.3	5.5	6.0	6.85	9.0	12.63	7.45	6.45	5.8	5.7	5.6	5.3
11	5.3	5.45	6.0	6.85	8.65	12.13	7.3	6.4	5.75	5.6	5.6	5.3
12	5.25	5.4	6.0	6.95	8.55	11.93	7.25	6.4	5.7	5.6	5.6	5.35
13	5.25	5.4	6.0	6.95	8.7	11.88	7.2	6.4	5.75	5.6	5.55	5.35
14	5.25	5.5	6.0	6.95	8.7	11.53	7.05	6.4	5.7	5.6	5.55	5.4
15	5.25	5.45	6.05	6.85	8.75	11.43	7.0	6.3	5.7	5.65	5.5	5.4
16	5.3	5.4	6.1	6.95	9.2	11.28	7.0	6.2	5.7	5.75	5.6	5.4
17	5.3	5.5	6.1	7.0	10.2	10.88	6.9	6.0	5.7	5.7	5.6	5.4
18	5.4	5.5	6.2	7.05	10.55	10.58	6.8	6.0	5.8	5.75	5.6	5.4
19	5.4	5.5	6.3	7.2	11.1	10.48	6.8	6.0	5.7	5.8	5.6	5.4
20	5.4	5.45	6.3	7.15	11.35	10.28	6.75	5.9	5.75	5.8	5.5	5.4
21	5.4	5.4	6.3	7.05	11.5	10.06	6.75	5.8	5.75	5.8	5.5	5.45
22	5.4	5.4	6.2	7.05	11.8	9.96	6.7	5.8	5.7	5.8	5.5	.....
23	5.3	5.4	6.2	6.95	12.2	9.81	6.7	5.8	5.7	5.8	5.5	.....
24	5.35	5.4	6.1	7.25	12.3	9.76	6.75	5.75	5.7	5.7	5.5	.....
25	5.35	5.4	6.0	7.45	11.9	9.56	6.7	5.7	5.7	5.7	5.5	.....
26	5.3	5.4	6.0	7.5	11.9	9.51	6.75	5.7	5.7	5.7	5.5	.....
27	5.3	5.5	6.0	7.75	11.95	9.41	6.8	5.7	5.7	5.7	5.55	.....
28	5.35	5.5	6.0	8.3	11.65	9.4	6.85	5.8	5.7	5.7	5.6	.....
29	5.3	.....	6.0	8.85	10.85	9.15	6.9	5.8	5.7	5.7	5.5	.....
30	5.4	.....	6.0	9.25	10.5	8.9	7.05	5.85	5.75	5.7	5.45	.....
31	5.5	.....	6.0	.....	10.95	.....	7.4	5.8	.....	5.75	.....	6.50

Station rating table for Gunnison River near Cory, Colo., from January 1 to December 21, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.20	430	6.60	1,630	8.00	3,810	9.80	8,490
5.30	480	6.70	1,750	8.10	4,010	10.00	9,180
5.40	530	6.80	1,870	8.20	4,210	10.20	9,910
5.50	590	6.90	2,000	8.30	4,410	10.40	10,660
5.60	660	7.00	2,130	8.40	4,620	10.60	11,450
5.70	730	7.10	2,270	8.50	4,840	10.80	12,280
5.80	810	7.20	2,420	8.60	5,070	11.00	13,130
5.90	900	7.30	2,570	8.70	5,300	11.20	14,000
6.00	990	7.40	2,730	8.80	5,540	11.40	14,880
6.10	1,090	7.50	2,900	8.90	5,790	11.60	15,790
6.20	1,190	7.60	3,070	9.00	6,050	11.80	16,730
6.30	1,290	7.70	3,250	9.20	6,600	12.00	17,700
6.40	1,400	7.80	3,430	9.40	7,190		
6.50	1,510	7.90	3,620	9.60	7,820		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905. It is fairly well defined above gage height 5.9 feet. Above gage height 12 feet the rating curve is a tangent, the difference being 500 per tenth.

Estimated monthly discharge of Gunnison River near Cory, Colo., for 1905.

[Drainage area, 5,233 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	590	455	503	30,930	0.096	0.111
February	590	530	563	31,270	0.108	0.112
March	1,290	660	1,013	62,290	0.194	0.224
April	6,745	900	2,251	133,900	0.430	0.480
May	19,200	4,310	10,320	634,600	1.97	2.27
June	23,200	5,790	14,110	839,600	2.70	3.01
July	5,420	1,750	2,643	162,500	0.505	0.582
August	3,070	730	1,306	80,300	0.250	0.288
September	945	730	775	46,120	0.148	0.165
October	810	660	744	45,750	0.142	0.164
November	770	560	645	38,380	0.123	0.137
December 1-21	560	480	517	21,530	0.099	0.077
The period				2,127,000		

GUNNISON RIVER AT WHITEWATER, COLO.

This station was regularly established April 10, 1902, incomplete series of gage heights having been obtained during 1895, 1897, and 1901. It is located at the steel wagon bridge constructed by the State of Colorado at a point about one-half mile above the railroad station at Whitewater, on the Denver and Rio Grande Railroad. It was intended that this station should replace that formerly maintained on the Gunnison at Grand Junction, which was abandoned on account of conditions that rendered accurate gagings impossible.

The channel is straight for 1,000 feet above and 500 feet below the station. The cross section at the bridge is 282 feet wide, is uniform in area, and is clean. The right bank is of alluvial material, with abrupt slopes about 14 feet high; the left bank is of the same material,

but slopes more gently and overflows at extreme high water. The bed of the stream is composed of cobblestones, coarse gravel, and sand, and is fairly permanent. At the center of the cross section the current is broken by cylindrical piers and old sheet piling, and a small area adjacent to these fills in with silt at low water but scours out during high water. There is but one channel at all stages. The current is moderate at low water but swift at high. Gage heights range from 3.5 to 14 feet.

Discharge measurements are made from the downstream side of the two-span steel bridge. A stay line is used at high water. The initial point for soundings is the edge of the capstone of the left masonry abutment on the downstream side of the bridge.

The gage, which was read twice daily during 1905 by James Page, was originally of wire, and was located on the downstream side of the right span. On April 8, 1904, the old gage was replaced by a new chain gage with the same datum. The gage scale is graduated from zero to 10 feet, with two markers, giving a range of 20 feet in gage heights. The length of the chain from the end of the weight to the center of the first marker is 21.59 feet. The second marker is 11.59 feet from end of weight and is used when gage heights are above 10 feet. The bench mark, established July 3, 1904, is a standard United States Geological Survey iron bench-mark post located about 40 feet southeast of the east end of the bridge; it is stamped 4,653.6 feet above sea level; the elevation of the bench mark above the datum of gage is 6.83 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 140, p 189; WS 16, p 140; 66, p 94; 85, p 42; 100, pp 64-65; 133, p 162.
Discharge: WS 85, p 43; 100, p 65; 133, p 163.
Discharge, monthly: WS 85, p 44; 100, p 67; 133, p 164.
Gage heights: WS 16, p 140; 66, p 95; 85, p 43; 100, p 66; 133, p 163.
Rating table: WS 85, p 44; 100, p 66; 133, p 164.

Discharge measurements of Gunnison River at Whitewater, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 30	R. I. Meeker	246	487	2.17	4.25	1,059
May 21	do	275	2,744	6.76	11.95	18,560
May 22	do	275	2,797	7.22	12.15	20,210
June 4	do	275	3,092	8.08	13.25	25,000
July 12	do	262	978	2.68	5.62	2,622
August 11	do	253	691	1.95	4.45	1,345
September 28	do	205	513	1.66	3.90	824

Daily gage height, in feet, of Gunnison River at Whitewater, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	4.3	9.4	11.65	7.7	6.4	4.0	4.65
2	4.3	10.1	12.45	7.35	6.15	4.05	4.65
3	4.35	9.6	12.75	7.1	5.65	3.9	4.45
4	4.25	8.85	13.15	6.85	5.3	3.95	4.35
5	4.4	8.35	13.85	6.55	5.15	4.6	4.25
6	4.25	7.75	13.6	6.45	5.05	4.4	4.2
7	4.2	7.65	13.05	6.25	5.05	4.45	4.25
8	4.5	7.95	13.2	6.05	4.95	4.35	4.15
9	4.85	8.7	13.5	6.05	4.75	4.25	4.05
10	5.1	8.8	13.55	5.95	4.6	4.2	4.0
11	5.55	8.35	12.95	5.8	4.45	4.05	3.95

Daily gage height, in feet, of Gunnison River at Whitewater, Colo., for 1905—**Continued.**

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
12	5.8	7.95	12.5	5.65	4.55	4.05	3.9
13	5.7	7.8	12.25	5.5	4.55	4.0	3.9
14	5.55	7.85	12.05	5.5	4.5	3.9	3.9
15	5.4	7.8	11.85	5.4	4.45	3.8	4.0
16	5.3	8.35	11.7	5.45	4.4	3.8	3.95
17	5.55	9.4	11.1	5.35	4.25	3.8	4.0
18	5.75	10.3	10.45	5.35	4.1	3.75	4.05
19	5.75	10.9	10.15	5.15	4.0	3.7	4.2
20	5.9	11.6	9.9	5.15	3.95	3.7	4.15
21	5.75	11.95	9.6	5.1	3.9	3.75	4.15
22	5.5	12.15	9.35	5.1	3.8	3.75	4.0
23	5.65	12.6	9.15	5.1	3.7	3.75	4.3
24	5.75	12.75	9.05	5.05	3.85	3.7	4.3
25	6.05	12.55	8.8	4.85	3.8	3.8	4.25
26	6.4	12.45	8.75	4.65	3.85	3.95	4.3
27	6.7	12.35	8.5	4.7	3.95	3.95	4.25
28	7.35	12.05	8.4	4.7	3.85	3.9	4.3
29	8.1	11.3	8.2	4.65	3.8	4.35	4.25
30	8.65	10.65	8.0	5.0	3.95	4.55	4.25
31	.....	10.95	.....	5.8	4.05	.....	4.25

Station rating table for Gunnison River at Whitewater, Colo., from April 1 to May 1, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	695	5.20	1,860	6.40	3,530	7.60	5,610
4.10	765	5.30	1,985	6.50	3,690	7.70	5,800
4.20	840	5.40	2,110	6.60	3,850	7.80	5,990
4.30	920	5.50	2,240	6.70	4,010	7.90	6,190
4.40	1,005	5.60	2,370	6.80	4,180	8.00	6,400
4.50	1,095	5.70	2,505	6.90	4,350	8.20	6,830
4.60	1,190	5.80	2,640	7.00	4,520	8.40	7,300
4.70	1,290	5.90	2,780	7.10	4,690	8.60	7,810
4.80	1,395	6.00	2,920	7.20	4,870	8.80	8,350
4.90	1,505	6.10	3,070	7.30	5,050	9.00	8,910
5.00	1,620	6.20	3,220	7.40	5,230	9.20	9,490
5.10	1,740	6.30	3,370	7.50	5,420	9.40	10,090

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 Below 7.8 feet the table is the same as for 1904.

Station rating table for Gunnison River at Whitewater, Colo., from May 2 to October 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	720	5.20	2,085	6.70	4,280	9.40	10,180
3.80	795	5.30	2,205	6.80	4,450	9.60	10,750
3.90	870	5.40	2.330	6.90	4,625	9.80	11,340
4.00	950	5.50	2,460	7.00	4,800	10.00	11,960
4.10	1,030	5.60	2,590	7.20	5,160	10.20	12,600
4.20	1,115	5.70	2,725	7.40	5,540	10.40	13,250
4.30	1,200	5.80	2,865	7.60	5,930	10.60	13,920
4.40	1,290	5.90	3,010	7.80	6,340	10.80	14,610
4.50	1,380	6.00	3,160	8.00	6,760	11.00	15,320
4.60	1,470	6.10	3,310	8.20	7,200	11.50	17,180
4.70	1,565	6.20	3,465	8.40	7,650	12.00	19,240
4.80	1,660	6.30	3,620	8.60	8,120	12.50	21,520
4.90	1,760	6.40	3,780	8.80	8,600	13.00	23,920
5.00	1,860	6.50	3,945	9.00	9,100	13.50	26,370
5.10	1,970	6.60	4,110	9.20	9,630		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905, and is fairly well defined.

Estimated monthly discharge of Gunnison River at Whitewater, Colo., for 1905.

[Drainage area, 7,868 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	7,945	840	2,494	148,400	.317	.354
May	22,710	6,030	12,720	782,100	1.62	1.87
June	28,080	6,760	16,810	1,000,000	2.14	2.39
July	6,130	1,518	2,783	171,100	.354	.408
August	3,780	720	1,429	87,860	.182	.210
September	1,470	720	962	57,240	.122	.136
October	1,518	870	1,103	67,820	.140	.161
The period				2,315,000		

NORTH FORK OF GUNNISON RIVER NEAR HOTCHKISS, COLO.

This station was established April 13, 1904. It is located 4 miles below Hotchkiss, Colo., on the ranch of L. Gorsuch, and replaces the station maintained during 1903 at the highway bridge one-half mile east of Hotchkiss and abandoned because of unsatisfactory conditions.

The channel is 180 feet wide and is straight for 800 feet both above and below the station. The banks are composed of alluvial material and are not liable to overflow. The bed of the stream is composed of large and small cobblestones, with some gravel, and changes only during extreme high water. There are two channels at low water, divided by a bar; at high stages there is but one channel. The current is swift at all stages. Gage heights range from 1 foot to 6 feet.

Discharge measurements are made by means of a cable and car, the property of the observer. The initial point for soundings is near the left end of the cable and is marked "zero" on the tag line. A stay line 40 feet upstream is used during high water.

The gage, which was observed during 1905 by L. Gorsuch, is an inclined timber, graduated from zero to 7 feet, and is located on the right bank about 800 feet downstream from

the cable. The bench mark is a point on a large bowlder on the right bank of the stream about 50 feet to the right of the gage, designated by a circle of white paint and marked "B. M.;" elevation above the zero of the gage, 9.34 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 167–170.

Discharge measurements of North Fork of Gunnison River near Hotchkiss, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 11	R. I. Meeker	160	204	3.78	3.10	771
May 7	Oro McDermith	164	365	4.94	3.95	1,802
May 20	A. A. Weiland	175	714	7.80	5.40	5,570
June 2	do	175	698	8.12	5.30	5,671
June 14	do	170	583	6.59	4.70	3,843
June 28	do	170	374	4.49	3.60	1,682
July 12	do	143	187	3.42	2.60	639
August 2	do	115	122	2.52	2.2	308
October 3	R. I. Meeker	65	48	2.35	1.78	113

Daily gage height, in feet, of North Fork of Gunnison River near Hotchkiss, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.3	2.6	2.52	5.0	5.45	3.25	2.45	1.28	1.88	1.8	1.75
2	2.3	2.32	2.75	2.6	5.32	5.55	3.2	2.3	1.18	1.8	1.8	1.7
3	2.3	2.35	2.8	2.58	4.65	5.45	3.02	2.18	1.15	1.78	1.75	1.7
4	2.3	2.4	2.7	2.55	4.2	5.8	2.95	2.1	1.20	1.7	1.75	1.7
5	2.35	2.4	2.6	2.55	4.05	5.95	2.95	2.05	1.25	1.7	1.7	1.75
6	2.35	2.4	2.6	2.65	3.85	5.45	2.9	2.0	1.32	1.7	1.7	1.75
7	2.38	2.35	2.6	2.85	3.92	5.45	2.82	2.0	1.42	1.7	1.7	1.75
8	2.4	2.3	2.58	3.02	4.35	5.45	2.85	1.92	1.48	1.68	1.7	1.8
9	2.4	2.25	2.5	3.15	4.75	5.7	2.75	1.88	1.4	1.65	1.7	1.8
10	2.4	2.25	2.5	3.28	4.35	5.45	2.72	1.78	1.35	1.65	1.7	1.82
11	2.4	2.25	2.5	3.3	4.1	5.25	2.62	1.78	1.32	1.65	1.7	1.82
12	2.38	2.25	2.5	3.35	4.15	5.1	2.58	1.82	1.25	1.65	1.65	1.88
13	2.35	2.2	2.5	3.35	4.25	5.05	2.52	1.88	1.25	1.65	1.65	1.88
14	2.35	2.2	2.5	3.35	4.15	4.95	2.5	1.82	1.25	1.7	1.65	1.88
15	2.32	2.2	2.58	3.25	4.25	4.9	2.48	1.78	1.25	1.7	1.72	1.92
16	2.3	2.2	2.65	3.32	4.6	4.7	2.42	1.72	1.25	1.7	1.75	1.92
17	2.3	2.2	2.68	3.32	5.08	4.5	2.4	1.62	1.25	1.75	1.8	1.95
18	2.35	2.25	2.7	3.35	5.38	4.35	2.32	1.52	1.3	1.78	1.8	1.95
19	2.35	2.28	2.6	3.52	5.6	4.15	2.3	1.42	1.32	1.68	1.75	1.95
20	2.3	2.3	2.62	3.35	5.7	4.02	2.3	1.42	1.3	1.65	1.7	1.95
21	2.2	2.3	2.62	3.28	5.7	3.95	2.22	1.4	1.3	1.6	1.65	2.05
22	2.2	2.32	2.58	3.32	5.9	3.78	2.2	1.35	1.3	1.65	1.68	2.05
23	2.2	2.25	2.52	3.32	6.0	3.72	2.18	1.3	1.3	1.72	1.82	2.05
24	2.2	2.25	2.5	3.55	6.0	3.72	2.1	1.22	1.32	1.8	1.78	2.15
25	2.25	2.28	2.5	3.68	5.7	3.7	2.08	1.2	1.42	1.75	1.68	2.15
26	2.25	2.28	2.5	3.62	5.7	3.6	2.05	1.22	1.48	1.7	1.78	2.15
27	2.3	2.25	2.6	3.82	5.65	3.5	2.0	1.4	1.5	1.7	1.95	2.22
28	2.35	2.3	2.58	4.2	5.55	3.55	1.98	1.42	1.5	1.7	2.0	2.2
29	2.35	.....	2.52	4.4	4.95	3.42	1.95	1.4	1.55	1.7	1.85	2.2
30	2.35	.....	2.5	4.65	4.65	3.35	2.1	1.35	1.82	1.72	1.8	2.2
31	2.35	.....	2.52	.....	5.25	.....	2.45	1.35	.....	1.8	.....	2.25

NOTE.—No ice record.

Station rating table for North Fork of Gunnison River near Hotchkiss, Colo., from January 1 to May 16, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.20	120	3.10	790	4.00	2,200	4.90	4,290
2.30	150	3.20	920	4.10	2,400	5.00	4,570
2.40	190	3.30	1,050	4.20	2,610	5.10	4,850
2.50	240	3.40	1,190	4.30	2,820	5.20	5,140
2.60	300	3.50	1,340	4.40	3,040	5.30	5,440
2.70	370	3.60	1,500	4.50	3,270	5.40	5,740
2.80	460	3.70	1,660	4.60	3,510		
2.90	560	3.80	1,830	4.70	3,760		
3.00	670	3.90	2,010	4.80	4,020		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined between gage heights 2.2 feet and 3.1 feet. Above gage height 3.5 the table is uncertain.

Station rating table for North Nork of Gunnison River near Hotchkiss, Colo., from May 17 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	0	2.10	260	3.20	1,280	4.60	3,680
1.10	2	2.20	320	3.30	1,410	4.80	4,150
1.20	8	2.30	390	3.40	1,540	5.00	4,640
1.30	18	2.40	460	3.50	1,680	5.20	5,140
1.40	32	2.50	540	3.60	1,830	5.40	5,660
1.50	50	2.60	630	3.70	1,980	5.60	6,190
1.60	75	2.70	720	3.80	2,140	5.80	6,740
1.70	105	2.80	820	3.90	2,310	6.00	7,300
1.80	135	2.90	930	4.00	2,480		
1.90	170	3.00	1,040	4.20	2,850		
2.00	210	3.10	1,160	4.40	3,250		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined above gage height 1.7 feet.

Estimated monthly discharge of North Fork of Gunnison River near Hotchkiss, Colo., for 1905.

[Drainage area, 850 square miles.]

Month.	Discharge in second-feet			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	190	120	159	9,777	0.187	0.216
February	190	120	146	8,108	.172	.179
March	460	240	292	17,950	.344	.397
April	3,635	252	1,162	69,140	1.37	1.53
May	7,300	1,920	4,476	275,200	5.27	6.08
June	7,160	1,475	3,986	237,200	4.69	5.23
July	1,345	190	577	35,480	.679	.783
August	500	8	125	7,686	.147	.170
September	142	5	27.5	1,636	.032	.036
October	163	75	108	6,641	.127	.146
November	210	90	121	7,200	.142	.158
December	355	105	199	12,240	.234	.270
The year	7,300	5	948	688,300	1.12	15.20

CIMARRON CREEK AT CIMARRON, COLO.

Cimarron Creek rises in the extreme southwestern part of Gunnison County and flows northward to its point of junction with Gunnison River. The drainage area is entirely mountainous. During the summer and fall short, heavy rainstorms occur frequently, and the rapid run-off induced by the steep slopes of the basin causes sudden fluctuations in gage heights.

The gaging station was established April 28, 1903. It is located at Smith's private bridge, 1,000 feet south of the Denver and Rio Grande Railroad station at Cimarron, in T. 48 N., R. 6 W., and about 1 mile above the mouth of Cimarron Creek.

The channel is straight for 100 feet above and 250 feet below the bridge. Both banks are low, rocky, and partly wooded and have not been known to overflow during the past ten years. The bed of the stream is composed of bowlders and cobblestones and is very rough, but is stable. The gradient is steep, though somewhat uneven. At low water there is but one channel. At high water there are two channels divided by the central pier of the bridge. The current is always rapid. Gage heights range from 1.5 to 4 feet. Accurate measurements are difficult to secure on account of the roughness of the section and the swift and irregular velocities.

Discharge measurements are made from the downstream side of the footbridge, which is supported by two log abutments and one log crib pier in the center of the stream. The initial point for soundings is the left abutment on the downstream side and is marked zero on the bridge. The bridge was washed away in June, 1905, but was replaced shortly afterwards at a greater elevation.

The gage, which was read during 1905 by J. L. Linscott, is a vertical staff graduated from zero to 6 feet, spiked to the face of the left abutment of the bridge on the downstream side. The bench mark consists of two nails driven into the root of a cottonwood tree 50 feet west of gage; elevation above the zero of the gage, 8.24 feet. This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 82-83; 133, p 165.
Discharge: 66, p 55; 85, p 77; 100, pp 83, 94; 133, p 165.
Discharge, monthly: 100, p 84; 133, p 167.
Gage heights: 100, pp 83-84; 133, p 166.
Rating table: 100, p 84; 133, p 166.

Discharge measurements of Cimarron Creek at Cimarron, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 1	R. I. Meeker	32	20	2.20	1.70	44
May 11	Oro McDermith	39	45	3.33	2.30	153
May 23	A. A. Weiland	47	108	6.67	3.50	720
May 23	R. I. Meeker	48	103	6.65	3.48	685
June 6	A. A. Weiland	47	140	7.76	4.20	1,087
June 19	do	62	103	5.99	3.45	617
July 18	do	33	28	3.00	2.00	84
August 11	do	35	23	2.30	1.85	53
October 5	R. I. Meeker	24	18	1.72	1.65	31

Daily gage height, in feet, of Cimarron Creek at Cimarron, Colo., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.95	2.65	3.7	2.85	2.5	1.63	1.77	1.63	1.55
2	.....	1.68	2.82	3.85	2.77	2.3	1.6	1.87	1.65	.....
3	.....	1.68	2.5	3.92	2.75	2.25	1.63	1.65	1.65	.....
4	.....	1.75	2.38	4.1	2.5	2.17	1.6	1.9	1.63	.....
5	.....	1.68	2.35	4.25	2.6	2.1	1.63	1.65	1.65	.....
6	.....	1.68	2.28	4.1	2.55	2.07	1.73	1.65	1.65	.....
7	.....	1.65	2.2	4.1	2.55	2.0	1.63	1.63	1.57	.....
8	.....	1.78	2.2	4.08	2.55	2.05	1.57	1.6	1.55	.....
9	.....	1.82	2.62	4.12	2.4	1.8	1.6	1.65	1.57	.....
10	1.8	1.82	2.28	4.03	2.45	1.7	1.57	1.65	1.55	.....
11	1.6	1.82	2.3	4.0	2.4	1.85	1.6	1.6	1.53	.....
12	1.75	1.78	2.28	3.91	2.35	1.8	1.6	1.55	1.53	.....
13	1.72	1.72	2.38	3.82	2.3	1.8	1.6	1.57	1.57	.....
14	1.75	1.75	2.3	3.8	2.25	1.77	1.63	1.55	1.6	.....
15	1.78	1.65	2.42	3.87	2.3	1.73	1.5	1.6	1.57	.....
16	1.78	1.7	2.85	3.65	2.15	1.7	1.47	1.6	1.57	.....
17	1.75	1.82	2.95	3.52	2.1	1.67	1.5	1.63	1.6	.....
18	1.78	1.82	3.0	3.53	2.0	1.7	1.63	1.6	1.57	.....
19	1.8	1.85	3.1	3.37	2.13	1.57	1.63	1.63	1.53	.....
20	1.82	1.78	3.1	3.33	2.3	1.63	1.57	1.6	1.57	.....
21	1.72	1.68	3.28	3.3	2.15	1.6	1.55	1.6	1.53	.....
22	1.8	1.78	3.55	3.3	2.15	1.6	1.63	1.63	1.55	.....
23	1.7	1.82	3.65	3.13	2.03	1.63	1.63	1.87	1.55	.....
24	1.78	1.78	3.4	3.2	1.9	1.63	1.63	1.63	1.5	.....
25	1.8	1.8	3.3	3.23	2.1	1.63	1.77	1.53	1.55	.....
26	1.72	1.85	3.5	3.1	2.1	1.6	1.67	1.63	1.53	.....
27	1.8	1.92	3.55	3.07	2.2	1.6	1.63	1.65	1.63	.....
28	1.75	2.25	3.5	3.05	2.15	1.63	1.7	1.63	1.57	.....
29	1.75	2.3	3.22	2.97	2.95	1.65	1.77	1.65	1.55	.....
30	1.78	2.4	3.2	2.95	2.85	1.7	2.05	1.65	1.55	.....
31	1.8	.....	3.45	.....	2.73	1.73	.....	1.7	.....	.....

NOTE.—River frozen during December.

Station rating table for Cimarron Creek at Cimarron, Colo., from March 10 to December 1, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	22	2.30	152	3.10	473	3.90	973
1.60	28	2.40	181	3.20	526	4.00	1,050
1.70	37	2.50	213	3.30	582	4.10	1,130
1.80	49	2.60	247	3.40	640	4.20	1,213
1.90	65	2.70	285	3.50	700	4.30	1,300
2.00	83	2.80	327	3.60	763		
2.10	105	2.90	373	3.70	830		
2.20	126	3.00	422	3.80	900		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is well defined between gage heights 1.7 feet and 3.5 feet.

Estimated monthly discharge of Cimarron Creek at Cimarron, Colo., for 1905.

[Drainage area, 210 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 10-31	52	28	44.5	1,942	.212	.173
April	181	32	57.5	3,422	.274	.305
May	796	126	389	23,920	1.85	2.13
June	1,256	397	796	47,360	3.79	4.23
July	397	65	185	11,380	.881	1.02
August	213	26	59.4	3,652	.283	.326
September	93	20	32.4	1,928	.154	.172
October	65	24	33.4	2,054	.159	.181
November	32	22	26.7	1,589	.127	.142
The period				97,250		

UNCOMPAHGRE RIVER NEAR COLONA, COLO.

This station was established April 9, 1904. It is located at the private road bridge of J. M. Duckett, in T. 47 N., R. 8 W., one-half mile above Eldredge siding on the Denver and Rio Grande Railroad and 3 miles above Colona, Colo. It is best reached by driving from Montrose. The station replaces one that was established August 10, 1903, at Kettle's bridge, 1 mile south of Colona, to take the place of the original station, which was located one-half mile northeast of Colona. Both of these stations were abandoned because of unsatisfactory conditions.

The channel is straight for about 300 feet above and below the station. The banks are about 4 feet high, are rocky and partly wooded, and neither is subject to overflow. The bed of the stream is composed of large and small cobblestones, and a loose deposit of silt shifts along each side. There is but one channel at all stages and the current is swift. Gage heights range from 0.5 foot to 4 feet. Accurate measurements are difficult to secure on account of the rough bed and steep gradient of the channel.

Discharge measurements are made from the downstream side of the 46.2-foot single-span bridge to which the gage is attached. The initial point for soundings is the downstream edge of the left abutment.

The gage, which was read during 1905 by Miss Clara Duckett, is an 8-foot board graduated from zero to 7 feet. It was spiked vertically to the upstream side of the left abutment. The high water of June, 1905, caused the pier to sink 0.18 foot during July, and on August 14, 1905, the gage was moved to the downstream side of the left pier and set at the original datum. The bench mark is the upper edge of a large screw set about 3 feet above the ground in an 8-inch willow tree 75 feet south and upstream from the right end of the bridge; elevation, 9.97 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 72-73; 133, pp 171-172.
Discharge: 100, p. 73; 133, p 172.
Discharge, monthly: 100, p 75; 133, p 174.
Gage heights: 100, p 74; 133, p 173.
Rating tables: 100, pp 74-75; 133, pp 173-174

Discharge measurements of Uncompahgre River near Colona, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft*
April 13	R. I. Meeker	46	49	2.84	1.10	139
May 3	Oro McDermith	47	91	4.27	1.90	389
May 18	A. A. Weiland	47	110	4.88	2.30	537
May 29	do	47	114	4.94	2.20	564
June 8	do	47	170	8.15	3.75	1,384
June 21	do	47	129	6.38	2.80	822
July 8	do	47	98	4.95	2.12	485
July 24	do	47	76	3.92	1.72	298
August 7	do	47	73	3.96	1.72	289
August 14	do	47	63	3.39	1.40	214
October 1	R. I. Meeker	43	57	3.25	1.56	185

Daily gage height, in feet, of Uncompahgre River near Colona, Colo., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.2	1.05	2.2	2.95	2.62	1.87	1.2	1.47	1.06	0.96
2	.....	1.15	1.1	2.25	3.25	2.42	1.97	1.2	1.22	1.11	.96
3	.....	1.15	1.0	1.9	3.4	2.32	1.97	1.2	1.27	1.11	.....
4	.....	1.0	.95	1.85	4.2	2.27	1.82	1.3	1.22	1.11	.....
5	0.7	1.1	.95	1.75	4.1	2.22	1.82	1.35	1.27	0.96	.....
6	.75	1.05	1.0	1.7	4.0	2.07	1.82	1.3	1.27	1.01	.....
7	.75	1.0	1.05	1.65	4.0	1.82	1.72	1.3	1.27	.96	.....
8	.7	1.0	1.15	1.75	4.1	1.82	1.72	1.3	1.22	1.01	.....
9	.7	1.0	1.2	1.9	4.2	1.92	1.72	1.3	1.22	1.01	.....
10	.7	1.0	1.3	1.75	4.0	1.92	1.62	1.3	1.22	.96	.....
11	.7	1.0	1.3	1.7	4.0	1.87	1.52	1.15	1.12	1.01	.....
12	.....	1.0	1.3	1.75	4.0	1.82	1.47	1.15	1.12	1.01	.....
13	.....	1.0	1.15	1.8	4.1	1.82	1.47	1.2	1.17	.96	.....
14	.....	1.0	1.0	1.7	4.05	1.92	1.6	1.2	1.12	.96	.....
15	.....	.9	1.0	1.8	4.0	2.02	1.6	1.15	1.07	1.01	.....
16	.....	.9	1.0	2.15	3.8	1.82	1.6	1.25	1.22	.96	.....
17	.....	.9	1.2	2.6	3.4	1.82	1.4	1.1	1.22	.96	.....
18	.....	.95	1.2	2.65	3.5	1.82	1.4	1.15	1.22	1.01	.....
19	.8	1.0	1.4	2.55	3.0	1.87	1.35	1.15	1.22	1.01	.....
20	.8	1.0	1.35	2.55	3.4	2.02	1.2	1.2	1.22	.96	.....
21	.85	1.0	1.35	2.5	3.2	1.87	1.2	1.1	1.22	.96	.....
22	.85	.95	1.2	2.9	2.95	1.87	1.2	1.15	1.12	1.01	.....
23	.9	1.0	1.7	2.9	3.0	1.72	1.1	1.15	1.12	.96	.....
24	.9	1.15	1.2	2.9	3.0	1.82	1.1	1.0	1.22	1.06	.....
25	.9	1.0	1.3	2.9	3.0	1.72	1.1	1.05	1.17	1.06	.....
26	.8	1.0	1.45	2.75	3.0	1.72	1.1	1.0	0.97	1.06	.....
27	.8	1.0	1.75	2.8	3.0	1.87	1.1	1.0	1.02	.96	.....
28	.9	1.0	1.9	2.75	3.0	1.97	1.25	1.15	1.07	.96	.....
29	.....	1.0	2.1	2.3	2.95	2.47	1.15	1.3	1.12	1.01	.....
30	.....	.9	2.1	2.2	2.8	2.87	1.35	1.15	1.12	1.01	.....
31	.....	.9	.....	2.65	.....	2.47	1.45	.....	1.17	.....	.....

NOTE.—River frozen February 12-18.

Station rating table for Uncompahgre River near Colona, Colo., from February 5 to December 2, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	75	1.60	275	2.50	645	3.40	1,165
.80	85	1.70	310	2.60	695	3.50	1,235
.90	100	1.80	345	2.70	750	3.60	1,305
1.00	120	1.90	380	2.80	805	3.70	1,380
1.10	140	2.00	420	2.90	860	3.80	1,460
1.20	165	2.10	460	3.00	920	3.90	1,540
1.30	190	2.20	505	3.10	980	4.00	1,625
1.40	215	2.30	550	3.20	1,040	4.10	1,710
1.50	245	2.40	595	3.30	1,100	4.20	1,800

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is fairly well defined between gage heights 1.2 feet and 3.8 feet.

Estimated monthly discharge of Uncompahgre River near Colona, Colo., for 1905.

[Drainage area, 433 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
February, 17 days	100	75	85.8	2,893	0.198	0.125
March	165	100	122	7,501	.282	.325
April	460	110	197	11,720	.455	.506
May	860	293	543	33,390	1.25	1.44
June	1,800	805	1,279	76,110	2.95	3.29
July	844	317	436	26,810	1.01	1.16
August	408	140	246	15,130	.568	.655
September	202	120	161	9,580	.372	.415
October	236	114	161	9,900	.372	.429
November	143	112	121	7,200	.279	.311
The period				200,200		

UNCOMPAHGRE RIVER AT MONTROSE, COLO.

This station was established April 22, 1903. It is located at the iron highway bridge west of Montrose and one-fourth mile west of the Denver and Rio Grande Railroad near Haskell Park.

The channel is straight for 100 feet above and 300 feet below the bridge. The right bank is of earth; the left bank is of earth below the bridge, but above the bridge is the steep slope of a shale bluff. Both banks are liable to overflow at extreme high water. The bed of the stream is composed of cobblestones and gravel and is quite rough. There is but one channel at all stages, broken during high water by the left pier of the bridge. The higher portion of the left side of the channel is covered with undergrowth which obstructs the flow during high stages. The current is rapid at all times. Gage heights range from 2 to 6 feet.

Discharge measurements are made from either side of the bridge. The initial point for soundings is at the inner edge of the lower cylinder bridge pier at the right bank.

The gage, which was read twice daily during 1905 by Herbert Reeves, is a vertical staff, graduated from zero to 8 feet, spiked to a wing dam 20 feet above the bridge. The zero of this gage, which was established April 15, 1904, is 1.45 feet higher than that of the original gage which it replaced. The bench mark consists of two nails driven into a blaze on the root of a cottonwood tree 50 feet to the right of the gage; elevation, 8.61 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, p 379-380; 100, p 70; 133, p 175.
Discharge: WS 50, p 380; 66, p 98; 100, p 70; 133, p 175.
Discharge, monthly: Ann 22, iv, p 392; WS 100, p 72; 133, p 177.
Gage heights: WS 11, p 69; 50, p 380; 100, p 71; 133, p 176.
Rating tables: WS 52, p 520; 100, pp 71-72; 133, p 176.

Discharge measurements of Uncompahgre River at Montrose, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 13	R. I. Meeker	35	40	2.72	2.40	109
May 9	Oro McDermith	37	66	4.21	3.22	278
May 25	A. A. Welland	43	120	5.64	4.30	677
June 4	R. I. Meeker	91	218	6.78	5.38	1,479
June 24	A. A. Welland	40	96	5.33	3.73	512
July 3	do	35	64	2.89	2.57	185
July 21	do	32	48	1.98	2.05	95
August 8	do	35	44	1.73	1.95	76
September 30	do	34	44	2.93	2.45	129

Daily gage height, in feet, of Uncompahgre River at Montrose, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	2.22	2.35	2.28	3.7	4.15	3.35	2.33	1.4	1.9	1.33	2.25
2	2.38	2.2	2.4	2.4	4.25	4.8	3.3	2.05	1.23	1.77	1.43	2.25
3	2.3	2.2	2.55	2.4	3.6	5.0	2.4	2.1	1.57	1.5	1.33	2.45
4	2.28	2.2	2.6	2.32	3.2	5.8	2.2	2.0	1.73	1.45	1.45	2.35
5	2.3	2.2	2.45	2.15	3.08	5.65	2.15	1.95	1.47	1.45	1.45	2.35
6	2.32	2.2	2.48	2.35	2.7	5.15	2.3	2.0	1.33	1.35	1.43	2.25
7	2.25	2.2	2.4	2.35	2.55	5.55	2.35	2.05	1.5	1.35	1.4	2.3
8	2.38	2.2	2.32	2.5	2.45	5.5	2.4	1.93	1.4	1.4	1.45	2.15
9	2.32	2.2	2.3	2.55	2.5	5.25	2.25	2.0	1.47	1.2	1.4	2.15
10	2.2	2.2	2.3	2.5	2.55	5.05	2.15	2.03	1.5	1.2	1.4	2.05
11	.....	2.2	2.3	2.45	2.75	5.25	2.15	1.93	1.4	1.2	1.4	2.25
12	.....	2.2	2.3	2.4	3.3	5.0	2.15	1.93	1.45	1.2	1.3	2.3
13	.....	2.2	2.3	2.4	3.35	4.85	2.25	2.25	1.57	1.2	1.2	2.35
14	.....	.....	2.3	2.4	3.62	4.7	2.1	2.0	1.5	1.23	1.35	2.3
15	.....	.....	2.3	2.25	3.62	4.53	2.15	1.95	1.5	1.23	1.5	2.25
16	.....	.....	2.2	2.02	3.65	4.6	2.25	1.93	1.5	1.2	1.35	2.1
17	.....	.....	2.2	2.02	3.5	4.45	2.15	1.9	1.47	1.2	1.45	2.2
18	.....	.....	2.25	2.02	3.6	4.3	2.0	1.73	1.35	1.17	1.35	2.3
19	2.25	.....	2.21	2.0	3.6	4.3	1.95	1.63	1.45	1.23	1.45	2.35
20	2.3	2.2	2.2	2.0	3.75	3.45	2.4	1.57	1.4	1.17	1.35	2.2
21	2.3	2.2	2.2	2.0	3.85	3.35	2.0	1.55	1.25	1.17	1.25	2.3
22	2.35	2.22	2.2	2.0	3.92	3.45	2.2	1.45	1.4	1.23	1.3	2.35
23	2.3	2.2	2.35	2.02	4.48	3.4	2.05	1.43	1.4	1.35	1.55	2.25
24	2.28	2.25	2.25	2.25	4.5	3.5	2.05	1.45	1.43	1.35	1.5	2.3
25	2.3	2.25	2.45	2.35	4.55	3.45	1.97	1.35	1.53	1.4	1.65	2.2
26	2.2	2.22	2.35	2.5	4.45	3.55	1.95	1.4	1.47	1.45	1.65	2.1
27	2.2	2.22	2.35	2.85	4.25	3.7	2.0	1.4	1.43	1.35	1.75	2.05
28	2.2	2.3	2.32	3.85	4.1	3.4	2.15	1.85	1.33	1.5	1.7	2.05
29	2.22	.....	2.25	3.88	4.0	3.25	2.75	1.53	1.55	1.5	1.75	2.05
30	2.22	.....	2.22	3.7	4.05	3.2	2.83	1.37	1.87	1.45	2.05	2.1
31	2.2	.....	2.3	.....	3.9	.....	2.8	1.37	.....	1.37	.....	2.15

NOTE.—River frozen January 11-17, February 14-19.

Station rating table for Uncompahgre River at Montrose, Colo., from January 1 to June 3, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	57	2.80	184	3.60	412	4.40	717
2.10	69	2.90	207	3.70	446	4.50	765
2.20	82	3.00	231	3.80	481	4.60	817
2.30	96	3.10	257	3.90	516	4.70	874
2.40	111	3.20	285	4.00	552	4.80	936
2.50	127	3.30	315	4.10	590	4.90	1,004
2.60	144	3.40	346	4.20	630	5.00	1,080
2.70	163	3.50	379	4.30	672		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is fairly well defined between gage heights 2 feet and 4.3 feet.

Station rating table for Uncompahgre River at Montrose, Colo., from June 4 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	6	2.00	86	3.00	288	4.00	595
1.10	10	2.10	100	3.10	315	4.20	671
1.20	14	2.20	116	3.20	343	4.40	755
1.30	19	2.30	133	3.30	371	4.60	850
1.40	25	2.40	151	3.40	400	4.80	970
1.50	32	2.50	170	3.50	430	5.00	1,125
1.60	40	2.60	191	3.60	461	5.20	1,300
1.70	50	2.70	213	3.70	493	5.40	1,500
1.80	61	2.80	237	3.80	526	5.60	1,725
1.90	73	2.90	262	3.90	560	5.80	1,970

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 2 feet and 4 feet. Below 1.9 the table is very uncertain. The table has been extended beyond these limits.

Estimated monthly discharge of Uncompahgre River at Montrose, Colo., for 1905.

[Drainage area, 565 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches
January (23 days)	108	82	93.1	4,247	.165	.141
February (22 days)	96	82	83.8	3,657	.148	.121
March	144	82	99.7	6,130	.176	.203
April	446	57	115	6,843	.204	[illegible]
May	791	119	433	26,620	.766	[illegible]
June	1,970	343	873	51,950	1.55	1.73
July	386	80	140	8,608	.248	[illegible]
August	138	22	64.4	3,960	.114	[illegible]
September	69	16	30.1	1,791	.053	[illegible]
October	73	13	23.3	1,433	.041	[illegible]
November	93	14	31.2	1,856	.055	[illegible]
December	160	93	121	7,440	.214	[illegible]
The period				124,500		

UNCOMPAHGRE RIVER AT DELTA, COLO.

This station was established April 29, 1903. It was originally located at a highway bridge one-fourth mile above the Denver and Rio Grande Railroad bridge, but on November 17, 1903, the station was removed to the Denver and Rio Grande Railroad bridge, one-fourth mile northwest of the Denver and Rio Grande Railroad station, in order that the measured discharge of the river might include the mill-ditch waste. Excluding the discharge of seasonal high water in May or June and an occasional rise from local storms, the water passing this station is entirely seepage water from irrigation above.

The channel at the gage rod and the bridge below is a long gentle curve. The right bank is of earth, is high and clean, and is not subject to overflow. The left bank is also of earth and is clean; but it is low and may overflow during extreme high water. The bed of the stream is composed of earth and fragments of rock and is fairly permanent. There is but one channel at all stages. The current is sluggish at low and swift at high water. Gage heights range from 0.6 foot to 4 feet.

Discharge measurements were originally made from the highway bridge, to which the first gage was attached, or by wading near the gage. From November 17, 1903, to May 2, 1904, measurements were made from the Denver and Rio Grande Railroad bridge. After the latter date measurements were made from the single-span road bridge 100 feet below the new gage. The initial point for soundings is the face of the left abutment at the downstream side of the road bridge and is marked by a brass-headed nail in the hand rail. At low-water measurements are made by wading near the bridge.

Gage readings at this station are made by Michael O'Rourke. The first gage at the railroad bridge was a vertical rod nailed to a 12-inch pile on the downstream side of the bridge. It read from 1 foot to 6 feet. Readings were taken from this gage until April 21, 1904, when a new gage was installed on the right bank 45 feet east of the center of the Denver and Rio Grande Railroad track at the south approach to the bridge. There is no definite and constant relation between the new and old rods as the cross sections are not identical. The new gage is an inclined rod, graduated up to 6 feet. The bottom of the rod rests on the river bottom and is held in place by six 2- by 4-inch timbers driven firmly into the bank. The bench mark for the vertical gage was a cross on the top of the lower chord of the bridge over the gage rod; its elevation was 8.75 feet above the zero of the gage. The bench mark for the inclined gage is a point marked with black paint and the letters "B. M.," on the surface of the northeast corner of the stone abutment where the south end of the steel bridge rests, on the downstream side; elevation, 7.36 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 67; 133, pp 177-178.
Discharge: 66, p 98; 100, p 68; 133, p 178.
Discharge, monthly: 100, p 69; 133, p 180.
Gage heights: 100, p 68; 133, p 179.
Rating tables: 100, p 69; 133, pp 179-180.

Discharge measurements of Uncompahgre River at Delta, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 12	R. I. Meeker	58	64	1.78	1.45	114
May 5	Oro McDermith	64	110	2.21	2.05	243
May 19	A. A. Weiland	64	179	4.95	3.30	887
May 31	do	64	145	3.23	2.42	469
June 12	do	64	240	5.88	3.90	1,411
June 26	do	64	122	2.93	2.22	358
July 11	do	49	38	.53	.80	20
July 31	do	47	40	.62	.90	25
October 2	R. I. Meeker	50	44	.82	1.00	36

Daily gage height, in feet, of Uncompahgre River at Delta, Colo., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.57	2.0	1.47	2.62	2.92	1.48	1.14	0.76	0.99	0.8	1.49
2	1.8	1.58	2.22	1.52	3.08	3.28	1.32	.98	.72	.95	.81	1.5
3	1.74	1.64	2.07	1.61	2.94	3.44	1.06	.9	.71	.91	.82	1.47
4	1.8	1.69	2.08	1.45	2.39	3.66	.96	.84	.76	.88	.83	1.5
5	1.76	1.73	1.98	1.36	2.06	4.2	.92	.8	.87	.86	.84	1.53
6	1.8	1.66	1.84	1.23	1.78	4.2	.88	.82	.86	.78	.84	1.5
7	1.84	1.62	1.79	1.2	1.72	3.79	.78	.88	.87	.82	.86	1.49
8	.....	1.64	1.76	1.4	1.87	4.0	.81	.82	.8	.84	.86	1.6
9	.....	1.54	1.67	1.42	2.0	4.23	.81	.81	.81	.84	.84	1.63
10	.....	1.5	1.59	1.49	1.91	4.38	.8	.78	.84	.84	.83	1.57
11	.....	1.58	1.53	1.46	1.67	3.97	.8	.78	.84	.82	.82	1.54
12	.....	1.5	1.49	1.44	1.5	3.88	.77	.81	.79	.83	.84	1.48
13	.....	1.39	1.47	1.22	1.43	3.7	.78	.8	.78	.82	.86	1.53
14	.....	1.35	1.47	1.13	1.38	3.57	.76	.81	.76	.82	.85	1.63
15	.....	.....	1.49	1.13	1.32	3.54	.76	.79	.76	.82	.84	1.68
16	.....	.....	1.5	1.03	1.55	3.45	.74	.72	.76	.82	.85	1.62
17	.....	.....	1.53	1.04	2.52	3.15	.73	.69	.7	.8	.91	1.63
18	.....	.....	1.58	0.95	2.94	3.03	.71	.69	.77	.78	.9	1.69
19	.....	.....	1.5	.98	3.34	3.0	.7	.71	.78	.79	.89	1.69
20	.....	.....	1.5	1.06	3.54	2.8	.68	.72	.79	.83	.9	1.64
21	.....	.....	1.56	.96	3.5	2.68	.68	.72	.82	.82	.91	1.7
22	1.56	1.68	1.59	.87	3.54	2.43	.7	.73	.82	.81	.9	1.77
23	1.6	1.66	1.59	.88	3.68	2.2	.74	.73	.83	.82	.88	1.88
24	1.62	1.63	1.47	.87	3.76	2.22	.74	.73	.84	.83	.88	1.94
25	1.61	1.66	1.45	.82	3.58	2.14	.69	.72	.78	.8	.93	.....
26	1.62	1.69	1.46	.78	3.53	2.12	.66	.78	.92	.82	1.0	.....
27	1.6	1.75	1.54	.76	3.41	2.08	.67	.77	.83	.82	1.13	.....
28	1.56	1.85	1.58	1.65	3.26	2.04	.7	.74	.84	.84	1.25	.....
29	1.5	.....	1.48	2.23	2.96	1.83	.68	.77	.84	.79	1.29	.....
30	1.56	.....	1.47	2.42	2.59	1.7	.7	.77	.85	.78	1.26	.....
31	1.56	.....	1.43	.....	2.56	.....	1.21	.76	.....	.8	.....	.....

NOTE.—River frozen January 8-21 and February 15-21.

Station rating table for Uncompahgre River at Delta, Colo., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	3	1.60	150	2.60	535	3.60	1,145
.70	8	1.70	180	2.70	585	3.70	1,220
.80	15	1.80	210	2.80	640	3.80	1,295
.90	24	1.90	240	2.90	695	3.90	1,375
1.00	35	2.00	275	3.00	750	4.00	1,455
1.10	50	2.10	315	3.10	810	4.10	1,535
1.20	65	2.20	355	3.20	870	4.20	1,620
1.30	85	2.30	395	3.30	935	4.30	1,710
1.40	105	2.40	440	3.40	1,005	4.40	1,800
1.50	125	2.50	485	3.50	1,075		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905, and is not well defined.

Estimated monthly discharge of Uncompahgre River at Delta, Colo., for 1905.

[Drainage area, 1,130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 1-7; 22-31	222	125	167	5,631	0.148	0.094
February 1-14; 22-28	225	95	157	6,539	.139	.109
March	363	111	161	9,900	.142	.164
April	449	6	88.1	5,242	.078	.087
May	1,265	89	597	36,710	.528	.609
June	1,782	180	894	53,200	.791	.882
July	121	6	21.0	1,291	.019	.022
August	56	8	15.3	941	.014	.016
September	26	8	15.8	940	.014	.016
October	34	14	18.1	1,113	.016	.018
November	83	15	27.9	1,660	.025	.028
December	254	119	156	7,426	.138	.123
The period				130,600		

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Gunnison River basin in 1905:

Miscellaneous discharge measurements made in Gunnison River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
August 10	Lotis Creek	Just above mouth	14	13	1.92	25
August 22	East River	1 mile below Brush Creek	40	34	1.88	64
August 22	Slate River	1 mile below Crested Butte, Colo.	60	34	1.12	38

COLORADO RIVER DRAINAGE BASIN BETWEEN JUNCTION OF GRAND AND GREEN RIVERS AND YUMA.

COLORADO RIVER.

DESCRIPTION OF RIVER.

From the junction of Grand and Green rivers the Colorado flows southwestward, passes across the northwestern corner of Arizona, then turns to the south and for the remainder of its course forms a part of the southeastern boundary of Nevada and California and the western boundary of Arizona. It empties into the Gulf of California about 60 miles below Yuma, Ariz. The canyons through which it flows are world famed and need not here be described.

The Colorado has been called the Nile of America, and like the Nile it is subject to an annual summer rise which comes at the time when it is most needed for irrigation. It is of interest to compare the Colorado with the Nile and Susquehanna rivers. The Nile being similar in type, the Susquehanna being contrasted and showing the difference in flow between arid and humid regions. In this comparison a normal year based upon records of the past ten years for the Colorado and Susquehanna rivers and such data as could be found in regard to the Nile has been used. The Colorado has been taken as the standard of comparison

The Nile has 5.7 times the drainage area and the Susquehanna about one-eighth the area.

The rainfall in the Nile basin is 3.8 times greater; that in the Susquehanna basin is 4.5 times greater. The run-off per square mile from the Nile basin is 1.9 times greater; that from the Susquehanna basin is 37 times greater. The ratio of run-off to rainfall in the Nile basin is 2 times smaller; that of the Susquehanna basin is 8.2 times greater.

The discharge of the Nile is 10.8 times greater; that of the Susquehanna is 4.5 times greater.

The maximum flow of the Colorado is from 70,000 to 110,000 second-feet and occurs in May, June, or July; for the Nile it is about 353,000 second-feet and occurs about the first of September; for the Susquehanna it is from 200,000 to 400,000 second-feet and occurs during March, April, and May.

The minimum flow of the Colorado is from 2,500 to 3,000 second-feet and occurs during January and February; that of the Nile is about 14,500 second-feet and occurs about the end of May; for the Susquehanna it is from 2,500 to 5,000 second-feet and occurs in September and October.

The mean flow of the Colorado is about 10,700 second-feet; for the Nile it is about 115,800 second-feet; for the Susquehanna it is about 43,000 second-feet.

The water of the Colorado carries an immense amount of sediment, reaching as high as 2,000 parts of sediment to 100,000 parts of water. Prof. R. H. Forbes, in Bulletin No. 44, University of Arizona Agricultural Experiment Station, says:

> On the basis of the profile constructed from available data for the volume of flow of the Colorado, and of the year's silt determinations made in the laboratory, it is estimated conservatively that the river during 1900 brought down about 61,000,000 tons of sedimentary material, which, condensed to the form of solid rock, is enough to cover 26.4 square miles 1 foot deep, or to make about 164 square miles of recently settled, submerged mud 1 foot deep, reckoning the whole amount of mud for the year to average 6.2 times the bulk of the solid sediment.

A comparatively small amount of land is irrigated by the waters of the Colorado, owing to the fact that the stream and its tributaries are situated so far below the level of the irrigable lands as to render their diversion extremely difficult or impracticable. There are two pumping plants that lift water for irrigation at Yuma and several at other points on the river above Yuma. The Imperial canal diverts water from the river at a point about 10 miles by river below Yuma.

The principal tributaries of the Colorado below the Grand and Green are the San Juan, Little Colorado, Bill Williams Fork, and Gila rivers, which enter from the east, and the Virgin River, which enters from the west. With the exception of the Virgin and Bill Williams Fork rivers, these streams and their various tributaries are described in other parts of this report.

COLORADO RIVER AT HARDYVILLE, ARIZ.

This station was established May 11, 1905. It is maintained in cooperation with the State of California, and is located one-fourth mile above the deserted town of Hardyville and 7 miles above Fort Mohave, Ariz.

The right bank is composed of cemented gravel, is high, and is not subject to overflow. The left bank is made up of alluvial material, easily eroded, is low and wooded, and is liable to overflow at flood stages. The bed is composed of cemented gravel and changes gradually as the river falls from flood stage to low water, a bar forming in that portion of the section nearest the right bank and altering the section materially. There is but one channel at all stages. The flow ranges from 3,000 to 100,000 second-feet, with velocities of from 2 to 8 feet per second and a variation of probably 12 feet in gage heights.

Discharge measurements are made from a car and cable located 250 feet above the pumping plant of the Rattan mill. The initial point for soundings is the end of the turn-buckle farthest from the river on the Nevada side.

The gage, which was read once each day during 1905 by Marion Herrick, is located 275 feet below the cable on the left bank. The gage is in two sections: The lower section is an inclined rod fastened to posts buried in the bank; the upper section is a timber set vertically

in the bank. The bench mark is the top of a 3-inch iron pipe buried in the gravel bank 100 feet from the river and 40 feet below the gage rod. Its elevation is 20.54 feet above the zero of the gage and 507.18 feet above sea level.

Discharge measurements of Colorado River at Hardyville, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 17	O. W. Peterson	6.65	33,140	August 13	C. W. Jenkins	4.20	12,270
May 20	do	6.95	33,910	August 27	do	4.00	11,650
May 27	C. W. Jenkins	11.20	69,010	September 2	do	3.20	5,934
June 4	do	10.50	64,750	September 17	do	3.40	7,523
June 10	do	14.50	107,700	October 1	do	3.00	4,657
June 18	do	12.80	81,030	October 15	do	3.90	6,579
June 25	do	10.15	52,860	October 29	do	3.60	6,574
July 9	do	6.70	30,650	November 4	Jenkins and Lee	3.48	5,949
July 16	do	5.70	22,400	November 12	C. W. Jenkins	3.85	6,504
July 23	do	5.10	17,620	November 19	do	3.70	5,979
July 30	do	4.60	14,590	November 25	do	3.60	5,757
August 6	do	5.00	17,040	December 3	do	6.00	17,850

Daily gage height, in feet, of Colorado River at Hardyville, Ariz., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	11.8	8.55	4.5	3.4	3.75	3.45	7.4
2	.....	11.5	8.4	4.5	3.4	4.05	3.45	7.1
3	.....	11.1	8.3	4.65	3.2	4.7	3.5	6.05
4	.....	10.7	8.0	4.8	3.2	4.35	3.45	5.35
5	.....	10.8	7.9	5.2	3.45	5.1	3.5	4.8
6	.....	11.85	7.55	5.0	3.55	4.8	3.5	4.5
7	.....	12.5	7.3	4.7	3.5	4.8	3.6	4.3
8	.....	13.1	7.0	4.7	3.6	4.7	4.0	4.2
9	.....	13.7	6.7	4.85	3.5	4.7	3.85	4.1
10	.....	14.4	6.7	4.6	3.6	4.45	3.85	3.9
11	6.85	14.3	6.5	4.5	4.0	4.25	3.75	3.75
12	6.9	14.0	6.15	4.3	3.7	4.1	3.85	3.75
13	6.95	14.3	6.0	4.25	3.5	4.0	3.8	3.8
14	7.15	14.45	5.85	4.15	3.5	3.95	3.65	3.8
15	7.15	14.5	5.2	4.0	3.45	3.85	3.85	3.7
16	6.95	13.8	5.85	4.0	3.45	3.8	3.75	3.7
17	6.7	13.3	5.5	3.9	3.4	3.7	3.7	3.7
18	6.8	12.8	5.3	3.8	3.3	3.7	3.7	3.7
19	6.95	12.5	5.25	3.8	3.2	3.7	3.7	3.6
20	7.0	12.2	5.2	3.8	3.2	3.6	3.7	3.6
21	7.35	11.85	5.1	3.75	3.05	3.55	3.6	3.65
22	8.1	11.35	5.1	3.75	3.05	3.5	3.6	3.7
23	8.8	10.8	5.1	3.6	3.0	3.5	3.6	3.8
24	9.5	10.5	4.95	3.6	3.05	3.5	3.7	3.8
25	9.9	10.15	4.85	3.6	2.95	3.45	3.6	3.8
26	10.6	10.0	4.7	4.75	2.95	3.5	5.4	3.95
27	11.1	9.5	4.7	3.7	2.95	3.45	5.4	3.9
28	11.5	9.1	4.7	3.4	2.95	3.5	5.1	3.9
29	12.7	9.2	4.7	3.3	3.95	3.55	5.0	3.9
30	12.4	9.6	4.65	3.4	3.95	3.5	5.1	3.8
31	12.1	.....	4.6	3.4	.....	3.5	.....	3.8

Daily discharge, in second-feet, of Colorado River at Hardyville, Ariz., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	73,460	45,260	14,080	7,160	9,290	5,650	29,500
2	.....	70,700	44,020	14,080	7,160	11,600	5,700	26,500
3	.....	67,090	43,200	15,090	5,970	15,900	6,000	18,200
4	.....	63,550	40,750	16,110	5,970	13,100	5,750	14,300
5	.....	64,430	39,940	18,950	7,460	18,200	5,800	11,500
6	.....	73,920	37,120	17,500	8,065	15,600	5,500	10,400
7	.....	80,000	35,120	15,430	7,760	15,300	6,000	10,200
8	.....	85,780	32,750	15,430	8,370	14,300	8,500	9,500
9	.....	91,700	30,410	16,460	7,760	14,000	7,200	8,800
10	.....	98,780	30,410	14,750	8,370	12,000	7,000	7,400
11	31,580	97,760	28,850	14,080	10,850	10,300	6,000	6,300
12	31,970	94,700	26,160	12,770	8,980	8,900	6,500	6,300
13	32,360	97,760	25,000	12,440	7,760	7,900	6,200	6,700
14	33,940	99,290	23,840	11,800	7,760	7,200	5,200	6,700
15	33,940	99,800	18,950	10,850	7,460	6,200	6,700	6,000
16	32,360	92,700	23,840	10,850	7,460	6,000	6,100	6,000
17	30,410	87,740	21,180	10,200	7,160	5,300	5,800	6,000
18	31,190	82,880	19,690	9,600	6,560	5,600	5,900	6,000
19	32,360	80,000	19,320	9,600	5,970	5,600	5,980	5,300
20	32,750	77,180	18,950	9,600	5,970	5,200	6,000	5,300
21	35,520	73,920	18,220	9,290	5,090	4,850	5,400	5,600
22	41,560	69,340	18,220	9,290	5,090	4,800	5,500	6,000
23	47,330	64,430	18,220	8,370	4,800	4,800	5,600	6,700
24	53,230	61,810	17,150	8,370	5,090	5,050	6,350	6,700
25	56,640	58,790	16,460	8,370	4,515	4,700	5,760	6,700
26	62,680	57,500	15,430	15,770	4,515	5,400	17,800	7,800
27	67,090	53,230	15,430	8,980	4,515	5,050	17,300	7,400
28	70,700	49,840	15,430	7,160	4,515	5,700	14,500	7,400
29	81,920	50,680	15,430	6,560	10,540	6,050	13,200	7,400
30	79,060	54,080	15,090	7,160	10,540	5,900	13,300	6,700
31	76,240	.....	14,750	7,160	.....	5,900	.....	6,700

NOTE.—Rating table used May 11 to October 1. For the remainder of the period indirect me hod was used.

Estimated monthly discharge of Colorado River at Hardyville, Ariz., for 1905.

[Drainage area, 138,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May 11 to 31	81,920	30,410	47,370	1,973,000	.342	.267
June	99,800	49,840	75,760	4,508,000	.547	.610
July	45,260	14,750	25,310	1,556,000	.183	.211
August	18,950	6,560	11,810	726,200	.085	.098
September	10,850	4,515	6,972	414,900	.050	.056
October	18,200	4,[illegible]00	8,571	527,000	.062	.071
November	17,800	5,200	7,606	452,600	.055	.061
December	29,500	5,300	9,097	559,400	.066	.076
The period	.....	.....	.....	10,720,000	.....	.....

SAN JUAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

San Juan River rises among the snow masses that crown the high peaks of the San Juan Mountains in southwestern Colorado, flows southwestward into New Mexico, then swings to the west and northwest, passing from San Juan County, N. Mex., across the extreme southwestern corner of Colorado into San Juan County, Utah, in the southwestern part of which it unites with the Colorado.

For the first 75 miles of its course the San Juan is a typical mountain stream, but at Canyon Largo, N. Mex., where it turns westward, its character changes, and it occupies a broad-winding, sandy channel in an arid valley, bordered on each side by terraced mesas. Below the mouth of Mancos River the valley narrows and the river bottom is bounded by abrupt bluffs, broken and cut by dry water channels, and merging farther on into the walls of a deep, narrow, box canyon in which the river flows to its end.

The drainage area includes portions of four States and Territories. Its topography ranges in type from mountainous at the headwaters in Colorado to the types exemplified in the valleys, plateaus, and eroded mesas of Utah, New Mexico, and Arizona. Large areas of eruptive rocks occur in the highest portions of the basin, but the predominating formations are of sedimentary origin. The headwater streams are protected by fine forests of spruce and yellow pine and, at lower elevations, large areas of aspen. The lower basin is practically barren except for an extensive growth of sagebrush, scattered cedars, piñons, and range grasses.

The principal tributaries of the San Juan are Navajo, Piedra, Pine, Florida, Animas, and La Plata rivers, the Animas being the most important.

Animas River has its source in the region above Silverton, draining portions of the Needle and La Plata mountains, the former being the most rugged of the Rocky Mountain ranges. The river flows southward to the Colorado-New Mexico line and thence southwestward to the point where it joins the San Juan at Farmington, N. Mex. The upper portion of the basin, above Durango, is very mountainous and furnishes the greater part of the run-off. This region is generally well timbered with pine, spruce, and aspen, but large areas consist of naked granite peaks. Immediately above and below Durango the valley broadens and is bordered by mesas and bluffs cut by narrow canyons and covered with sagebrush and scattered pines and piñons; along the stream channels cottonwoods predominate. The rocks of this region are chiefly of sedimentary origin. The soils of the lower valleys consist of sandy loam and are very fertile.

La Plata River rises in the granite masses known as La Plata Mountains, about 25 miles northwest of Durango, Colo., and flows southward to its point of junction with the San Juan. Its drainage basin is a narrow strip parallel to and adjoining the Animas basin. The upper portion of the basin is a well-watered and forest-clad mountain region which merges southward into an arid mesa, plateau, and canyon country. La Plata Valley proper is a narrow, shallow depression from Hesperus down, bounded on both sides by high, broken table-lands and deeply eroded mountains. The lower mountain slopes are covered with piñon, scrub oak, and cedar; the lower valleys support heavy growths of sagebrush and chico; the upper mountain slopes were at one time heavily timbered with spruce and yellow and white pine, but these forests have been largely removed by lumbermen.

The other tributaries of the San Juan need not here be described. Those mentioned are perennial streams but much of their water is diverted for irrigation and never reaches the main river. In addition to the perennial streams are many intermittent creeks throughout New Mexico which contribute large volumes of water during heavy storms.

Much land is now under cultivation along the valleys of the San Juan, Animas, Pine, Florida, and La Plata rivers and the smaller tributaries in Colorado. Numerous small lakes high up in the mountains tend to equalize the flow of some of the tributaries, and many large and small storage-reservoir sites are available which will in time be developed.

One large power plant has been constructed in this basin and others are contemplated. The largest deposits of lignite and bituminous and coking coal to be found in the West are in this drainage area.

SAN JUAN RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904. It is located near the Methodist Indian school about 3 miles south of Farmington, N. Mex., and about 2 miles below the mouth of Animas River.

The channel is straight for about 900 feet above and below the station. The right bank is a high sandstone cliff and can not overflow. The left bank at low water is a gravel bar extending out to 325 feet from the initial point for soundings, when it rises to a height of 6 feet; it probably never overflows beyond this point. The bed of the stream is composed of cobblestones, shale, and a few large, scattered bowlders. It is clean and permanent except on the left side where sand rests on the shale. There is but one channel at all stages. The current is swift at high and medium at low water. Gage heights range from 3 to 12 feet.

Discharge measurements were made from the suspension footbridge, which was carried away by the high water of 1905. Since then discharge measurements have been impracticable as there is no other bridge on the river.

The gage, which was read during 1905 by Elmer King, is a standard chain gage and is attached to a framework extending from the top of a sandstone cliff, about 15 feet above low water, on the right bank of the river, about 300 yards above the bridge. The gage scale is placed horizontally on the top of the cliff and is graduated from zero to 20 feet. The length of the wire from the end of the weight to the marker, which is a knot tied in the wire near the ring, is 20.79 feet. On May 23, 1905, a high-water gage, consisting of an inclined staff graduated to read from 8.6 to 16.4 feet, was set in the right bank about 150 feet below the wire gage. The bench mark is a cross, painted black and marked "U. S. G. S. B. M.," on the top of the sandstone cliff about 50 feet east of the gage: elevation above the datum of the wire gage, 12.79 feet. The top of the gage rod (above the brace) is 0.82 foot above the bench mark. The elevation of the bench mark above the datum of the new gage is 12.94 feet, and hence the datum of the new gage is 0.15 foot above the datum of the old gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 180–183.

A measurement made by M. C. Hinderlider May 23, 1905, gave the following results: Width, 302 feet; area, 1,764 square miles; mean velocity, 9.73 feet per second; gage height, 10.55 feet; discharge, 17,170 second-feet.

Daily gage height, in feet, of San Juan River near Farmington, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.22	3.3	4.15	4.18	7.0	10.05	7.4	5.55	4.25	5.95	4.22	4.18
2	3.35	3.4	4.25	4.32	7.5	10.7	6.15	5.3	4.28	5.5	4.25	4.15
3	3.3	3.35	4.75	4.4	7.25	12.4	6.05	5.0	4.22	5.12	4.2	4.18
4	3.25	3.35	5.1	4.15	6.9	12.25	6.0	4.95	4.32	4.85	4.22	4.25
5	3.3	3.75	5.0	4.15	6.75	12.35	6.0	4.95	4.68	4.75	4.2	4.28
6	3.15	3.68	4.95	4.35	6.6	13.1	5.85	4.9	4.65	4.55	4.22	4.28
7	3.2	3.55	5.4	4.5	6.4	11.65	5.6	4.8	4.62	4.52	4.25	4.3
8	3.3	3.58	5.05	4.88	6.35	11.8	5.85	4.7	4.65	4.48	4.32	4.22
9	3.22	3.5	4.6	4.75	6.2	12.0	5.8	4.65	4.58	4.48	4.22	4.18
10	3.3	3.55	4.45	5.0	6.4	11.9	5.65	4.55	4.55	4.55	4.2	4.2
11	3.22	3.45	4.15	6.95	6.3	12.0	5.6	4.7	4.55	4.52	4.15	4.15
12	3.1	3.85	4.25	7.1	6.05	12.05	5.45	4.7	4.55	4.45	4.2	4.2
13	3.1	3.2	4.15	6.35	5.95	11.9	5.4	4.8	4.5	4.48	4.15	4.2

Daily gage height, in feet, of San Juan River near Farmington, N. Mex., for 1905—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
14	3.12	3.35	4.15	6.15	6.05	11.6	5.25	4.7	4.5	4.48	4.18	4.18
15	2.75	3.35	4.55	6.22	6.1	11.4	5.15	4.55	4.45	4.45	4.2	4.15
16	3.25	3.25	4.55	6.35	6.7	11.4	5.2	4.45	4.45	4.42	4.2	4.2
17	3.3	3.3	4.6	6.0	7.65	11.75	5.15	4.4	4.42	4.4	4.22	4.2
18	3.35	3.35	4.8	5.9	8.0	10.6	5.1	4.35	4.38	4.38	4.2	4.12
19	3.35	3.4	4.7	5.95	8.35	10.7	5.15	4.25	4.32	4.38	4.2	4.15
20	3.1	3.4	4.7	5.95	8.75	10.75	5.1	4.12	4.32	4.3	4.2	4.2
21	3.15	3.4	4.65	5.8	8.8	9.9	5.05	4.08	4.35	4.28	4.15	4.2
22	3.38	3.8	4.48	5.95	8.1	10.05	5.2	4.05	4.3	4.3	4.6	4.1
23	3.2	5.02	4.0	6.75	11.2	10.0	5.1	3.95	4.28	4.28	4.4	3.95
24	3.2	4.95	3.9	7.0	11.05	9.85	5.05	4.65	4.3	4.28	4.2	4.0
25	3.25	4.85	4.12	6.55	11.1	9.75	5.05	4.52	4.58	4.3	4.15	3.98
26	3.2	4.25	4.18	6.15	10.85	9.55	4.85	4.1	4.6	4.22	4.18	4.0
27	3.2	3.95	4.42	6.1	11.0	9.6	4.82	4.15	4.62	4.28	4.9	4.12
28	3.2	4.0	4.2	6.55	10.15	9.55	4.9	4.28	4.6	4.28	5.08	4.2
29	3.22	.....	4.15	6.8	9.95	8.45	4.95	4.25	4.62	4.3	4.75	4.0
30	3.2	.....	4.2	6.7	9.55	8.4	6.25	4.4	6.05	4.25	4.15	4.05
31	3.2	.....	4.15	.....	9.55	.....	5.65	4.2	.....	4.28	.....	3.95

Station rating table for San Juan River near Farmington, N. Mex., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	25	4.00	900	5.60	3,850	8.20	10,400
2.80	55	4.10	1,020	5.80	4,290	8.40	10,960
2.90	90	4.20	1,150	6.00	4,750	8.60	11,520
3.00	130	4.30	1,300	6.20	5,230	8.80	12,080
3.10	180	4.40	1,450	6.40	5,710	9.00	12,640
3.20	230	4.50	1,610	6.60	6,200	9.50	14,050
3.30	290	4.60	1,780	6.80	6,700	10.00	15,500
3.40	350	4.70	1,950	7.00	7,200	10.50	17,000
3.50	420	4.80	2,140	7.20	7,720	11.00	18,500
3.60	500	4.90	2,340	7.40	8,240	11.50	20,000
3.70	580	5.00	2,540	7.60	8,780	12.00	21,500
3.80	680	5.20	2,970	7.80	9,320	12.50	23,000
3.90	780	5.40	3,410	8.00	9,860	13.00	24,500

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904, and one high-water measurement made during 1905. Low-water estimates based on this table are therefore uncertain. The table has been extended beyond these limits.

Estimated monthly discharge of San Juan River near Farmington, N. Mex., for 1905.

[Drainage area, 6,920 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	338	40	242	14,880	0.035	0.040
February	2,582	230	682	37,880	.099	.103
March	3,410	780	1,625	99,920	.235	.271
April	7,460	1,085	4,290	255,300	.620	.692
May	19,100	4,635	10,110	621,600	1.46	1.68
June	24,800	10,960	18,270	1,087,000	2.64	2.94
July	8,240	2,180	3,604	221,600	.521	.601
August	3,740	840	1,747	107,400	.252	.290
September	4,870	1,180	1,673	99,550	.242	.270
October	4,635	1,180	1,690	103,900	.244	.281
November	2,708	1,085	1,306	77,710	.189	.211
December	1,300	840	1,084	66,650	.157	.181
The year	24,800	40	3,860	2,793,000	.558	7.56

ANIMAS RIVER AT DURANGO, COLO.

This station was established June 20, 1895, and has been maintained during the greater part of each year since. It was originally located at the old wagon bridge, one-fourth mile west of the railroad bridge, at Durango and about 200 feet above the Rio Grande Southern Railroad bridge. On June 20, 1901, the station was removed to a new bridge, located just below the site of the old one.

The channel is straight for 300 feet above and 400 feet below the station. Both banks are high and rocky and not liable to overflow. The bed of the stream is rocky and fairly permanent. There is but one channel at all stages, broken by the center pier of the bridge. Gage heights range from 6 to 13 feet. During the high water of 1905 such radical changes occurred in the channel as to make two rating tables necessary.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the downstream edge of the right abutment.

The gage at this station was read twice daily during 1905 by C. G. Graden. The original gage was spiked to the west side of the south end of the middle pier of the wagon bridge. The head of a bolt at the east abutment of the railroad bridge is 17.24 feet above this gage datum. During the early part of 1899 the old wagon bridge was removed and a new one was constructed a short distance below. On April 1, 1899, a gage was fastened to the central pier of this bridge. Owing to this change in the location and height of the rod there is no apparent relation between the rating tables before and after 1899. The present gage, established June 20, 1901, is a vertical 14-foot timber, fastened to the southwest corner of the center masonry pier on the downstream side of the new wagon bridge, one-eighth mile west of the railroad station at Durango. The timber is held in place by spikes driven into cracks in the masonry. The gage is referred to bench marks as follows: (1) A chiseled point at the southwest corner of the center pier of the highway bridge; elevation 16.75 feet above the zero of the gage. (2) A chiseled point on the lower side of the left abutment of the bridge; elevation, 16.84 feet above the zero of the gage. On April 1 and 2, 1903, sand and gravel were washed down by Lightner Creek, which enters about 100 feet below the bridge, and were deposited around the gage rod. On April 14, 1903, a new wire gage was established on the downstream side of the bridge in the span next the left bank. This gage was read until June 6, when it was stolen. In the meantime the sand and gravel had been washed from the foot of the old gage, from which readings were taken thereafter.

The wire gage read zero when the vertical gage read 5 feet. All 1903 readings were reduced to the datum of the vertical gage.

This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 283-284; Bull 140, pp 198-199; WS 16. p 146; 28, p 132; 38, p 310; 50, p 383; 66, p 97; 85, pp 35-36; 100, pp 51-52; 133, pp 183-184.

Discharge: Ann 18, iv, p 284; Bull 140, p 199; WS 16, p 146; 28, p 142; 38, p 310; 50, p 383; 66, p 97; 85, p 36; 100, p 52; 133, p 185.

Discharge, monthly: Ann 18, iv, p 285; 19 iv, p 414; 20, iv, pp 379, 403; 21, iv, p 301; 22, iv, p 394; WS 85, p 37; 100 p 54; 133, p 186.

Discharge, yearly: Ann 20, iv, p 59.

Gage heights: Bull 140, p 200; WS 11, p 72; 16, p 146; 28, p 139; 38, p 311; 50, p 384; 66, p 97; 85, p 36; 100, p 53; 133, p 185.

Hydrographs: Ann 18, iv, p 285; 19, iv, p 415; 20, iv, p 403; 21, iv, p 301; 22, iv, p 394.

Rainfall and run-off relation: Ann 20, iv, p 379.

Rating tables: Ann 18, iv, p 284; 19, iv, p 414; Bull 140, p 199; WS 28, p 145; 39, p 452; 52, p 520; 66, p 174; 85, p 37; 100, p 53; 133, p 186.

Discharge measurements of Animas River at Durango, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 25	M. C. Hinderlider	89	195	6.14	8.70	1,198
May 16	do	189	513	6.49	10.00	3,330
May 20	do	189	756	6.85	11.00	5,179
July 3	O. H. Timmerman	183	648	4.32	8.75	2,703
July 13	do	158	435	3.04	7.90	1,321
July 14	do	158	446	3.05	7.93	1,360
July 14	do	158	448	3.16	8.00	1,417
July 31	do	163	509	3.80	8.30	1,935
August 7	do	156	407	2.50	7.75	1,017
August 18	do	143	296	1.99	7.00	590
August 30	do	143	273	1.92	6.90	525
September 9	do	143	281	1.84	7.05	516
September 15	do	143	239	1.64	6.90	391
September 20	do	143	223	1.59	6.86	355
September 28	do	143	244	1.62	6.90	396
September 29	do	143	318	2.17	7.38	690
October 1	do	163	440	3.66	8.04	1,514
October 1	do	163	434	3.33	7.96	1,447
October 2	do	163	390	2.71	7.80	1,057
October 2	do	163	382	2.74	7.78	1,048
October 3	do	160	370	2.54	7.64	939
October 3	do	158	362	2.56	7.61	928
October 5	do	158	324	2.32	7.42	757

Daily gage height, in feet, of Animas River at Durango, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.6	9.9	11.9	9.0	8.2	7.0	7.8	6.8	6.7
2	7.8	10.4	12.05	8.7	8.0	7.0	7.7	6.8	6.7
3	7.8	10.0	12.3	8.7	8.0	7.0	7.5	6.7	6.6
4	8.0	9.6	12.6	8.6	8.0	7.0	7.5	6.7	6.6
5	8.1	9.4	12.45	8.4	8.0	7.0	7.5	6.7	6.6
6	8.2	8.6	12.0	8.4	8.0	7.0	7.3	6.7	6.6
7	8.2	8.6	12.0	8.4	7.9	7.0	7.3	6.7	6.6
8	8.4	8.7	12.5	8.4	7.7	7.0	7.2	6.7	6.6
9	8.4	8.7	11.9	8.4	7.7	7.0	7.2	6.7	6.6
10	8.5	8.7	11.8	8.3	7.5	7.0	7.0	6.7	6.6
11	8.6	8.8	11.6	8.3	7.6	7.0	7.0	6.7	6.6
12	8.6	8.7	11.7	8.1	7.6	6.9	7.0	6.7	6.6
13	8.7	8.8	11.7	8.0	7.5	6.9	7.0	6.7	6.6
14	8.6	9.0	11.5	8.0	7.3	6.9	7.0	6.7	6.6
15	8.6	9.3	11.5	8.0	7.3	6.9	7.0	6.7	6.6
16	8.7	9.5	11.3	8.0	7.2	6.9	6.9	6.6	6.6
17	8.8	10.2	11.4	8.0	7.2	6.9	6.9	6.6	6.6
18	9.0	11.2	11.4	8.0	7.1	6.8	6.9	6.6	6.6
19	8.9	11.3	11.3	8.0	7.1	6.8	6.9	6.7	6.6
20	8.9	11.4	11.3	8.1	7.0	6.8	6.9	6.7	6.6
21	8.9	11.6	11.1	8.2	7.0	6.8	6.8	6.7	6.6
22	8.8	11.5	11.2	8.2	7.0	6.8	6.8	6.7	6.6
23	8.9	11.8	10.8	8.2	7.0	6.8	6.8	6.7	6.6
24	9.1	11.8	10.5	8.0	7.2	6.8	6.8	6.7	6.6
25	9.4	11.6	10.3	7.8	7.0	6.9	6.8	6.7	6.6
26	9.3	11.85	10.0	7.8	7.0	6.8	6.8	6.7	6.6
27	9.3	11.5	9.6	7.8	7.0	7.0	6.8	6.7	6.6
28	9.6	11.1	9.5	8.0	7.0	7.2	6.8	6.7	6.6
29	9.8	10.7	9.1	8.6	7.0	9.0	6.8	6.7	.....
30	9.8	11.25	9.0	9.0	7.0	7.8	6.9	6.7	.....
31	.....	11.6	.....	8.7	7.0	.....	6.9	.....	.....

Station rating table for Animas River at Durango, Colo., from April 1 to June 4, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.60	550	8.70	1,340	9.80	2 980	10.90	4,970
7.70	600	8.80	1,450	9.90	3,150	11.00	5,160
7.80	650	8.90	1,570	10.00	3,320	11.20	5,550
7.90	700	9.00	1,700	10.10	3,490	11.40	5,950
8.00	760	9.10	1,840	10.20	3,670	11.60	6,350
8.10	820	9.20	1,990	10.30	3,850	11.80	6,750
8.20	890	9.30	2,150	10.40	4,050	12.00	7,150
8.30	960	9.40	2,310	10.50	4,210	12.20	7,590
8.40	1,040	9.50	2,470	10.60	4,400	12.40	8,030
8.50	1,130	9.60	2,640	10.70	4,590	12.60	8,470
8.60	1,230	9.70	2,810	10.80	4,780		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is very poorly defined. Estimates based upon it are roughly approximate.

Station rating table for Animas River at Durango, Colo., from June 5 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.60	240	7.80	1,160	9.00	2,930	10.40	5,030
6.70	290	7.90	1,290	9.10	3,080	10.60	5,330
6.80	350	8.00	1,430	9.20	3,230	10.80	5,630
6.90	410	8.10	1,580	9.30	3,380	11.00	5,930
7.00	470	8.20	1,730	9.40	3,530	11.20	6,230
7.10	540	8.30	1,880	9.50	3,680	11.40	6,550
7.20	610	8.40	2,030	9.60	3,830	11.60	6,870
7.30	690	8.50	2,180	9.70	3,980	11.80	7,190
7.40	770	8.60	2,330	9.80	4,130	12.00	7,510
7.50	850	8.70	2,480	9.90	4,280	12.50	8,310
7.60	940	8.80	2,630	10.00	4,430		
7.70	1,040	8.90	2,780	10.20	4,730		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is fairly well defined between gage heights 6.9 feet and 8.8 feet. Above 9 feet the table is very uncertain.

Estimated monthly discharge of Animas River at Durango, Colo., for 1905.

[Drainage area, 812 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
April	2,980	550	1,465	87,170	1.80	2.01
May	6,850	1,230	3,894	239,400	4.80	5.53
June	8,470	2,930	6,297	374,700	7.75	8.65
July	2,930	1,160	1,825	112,200	2.25	2.59
August	1,730	470	816	50,170	1.00	1.15
September	2,930	350	534	31,780	.658	.734
October	1,160	350	522	32,100	.643	.741
November	350	240	290	17,260	.357	.398
December	290	240	243	14,940	.299	.345
The period				959,700		

ANIMAS RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904. It is located at the highway bridge about 1 mile northeast of Farmington, N. Mex.

The channel is straight for about 900 feet above and below the station. The right bank is a gradually sloping gravel bar, covered with small cobblestones and scattered trees and shrubs; it has been known to overflow, but this is an extremely rare occurrence. The left bank is a flat, grassy, perpendicular bank, 5 or 6 feet above low water, is lined with willows, and is not liable to overflow. The bed of the stream is composed of gravel, cobblestones, and silt, is free from vegetation, and is permanent The current is moderately swift.

Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is the west face of the left abutment and is marked zero with black paint on the bridge floor.

A standard chain gage, which is read twice each day by Mrs. Adellie Ricketts, is attached to the downstream side of the bridge, 40 feet from the left end. The gage scale is graduated from 2 to 7.8 feet. The length of the chain is 12.78 feet. The bench mark is a United States Geological Survey standard bench-mark tablet set into the southwest face of a 12-inch cottonwood tree about 50 feet north of the right end of the bridge; its elevation is 11.13 feet above the datum of the gage and 3.17 feet below the top of the horizontal bridge chord on which the gage box rests.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 191–195.

Discharge measurements of Animas River near Farmington, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 24	M. C. Hinderlider	179	849	7.72	8.34	6,555
July 6	O. H. Timmerman	144	449	3.59	6.25	1,611
July 20	do	141	323	2.71	5.35	876
July 27	do	141	280	2.45	5.05	687
August 2	do	146	399	3.40	5.82	1,357
August 9	do	126	286	2.56	5.10	732
August 21	do	112	172	1.31	4.22	226
August 24	do	107	139	1.00	3.92	139
August 24	do	107	136	1.00	3.92	136
August 26	do	75	122	.93	3.90	114
August 26	do	75	120	.93	3.90	112
September 12	do	107	139	1.62	4.19	226
October 8	do	137	269	2.26	5.02	618

Daily gage height, in feet, of Animas River near Farmington, N. Mex., for 1905.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	4.53	4.47	4.92	5.34	7.08	8.29	7.32	6.03	3.84	6.4
2	4.59	4.56	5.2	5.3	7.26	8.8	7.06	5.78	3.81	5.94
3	4.51	4.5	5.2	5.24	6.99	9.29	6.78	5.64	3.76	5.66
4	4.5	4.59	5.37	5.22	6.64	9.4	6.6	5.58	3.82	5.44
5	4.48	4.52	5.43	5.25	6.38	9.75	6.54	5.5	4.26	5.34
6	4.48	4.44	5.56	5.3	6.19	9.72	6.36	5.46	4.47	5.22
7	4.57	4.37	5.66	5.52	6.18	9.55	6.2	5.37	4.38	5.14
8	4.46	4.32	5.66	5.77	6.27	9.7	6.2	5.2	4.34	5.04
9	4.49	4.22	5.36	5.88	6.4	9.6	6.08	5.05	4.3	4.98
10	4.38	4.16	5.3	5.89	6.46	9.3	5.92	4.94	4.22	4.95
11	4.38	4.28	5.3	5.92	6.37	9.12	5.8	4.94	4.18	4.93
12	4.3	4.28	5.26	6.6	6.22	9.02	5.7	5.05	4.16	4.86
13	4.36	4.2	5.22	6.3	6.3	9.0	5.56	5.0	4.18	4.81
14	4.32	4.06	5.28	6.1	6.4	8.91	5.42	4.9	4.11	4.76
15	4.3	4.28	5.48	5.85	6.46	8.88	5.58	4.78	4.16	4.68
16	4.3	4.18	5.32	5.9	6.8	9.04	5.7	4.71	4.14	4.6
17	4.34	4.3	5.28	5.94	7.32	8.68	5.51	4.66	4.07	4.56
18	4.38	4.3	5.36	5.91	7.67	8.52	5.4	4.53	4.0	4.57
19	4.38	4.33	5.54	5.92	7.82	8.49	5.35	4.41	3.96	4.54
20	4.36	4.3	5.52	5.9	7.98	8.36	5.32	4.36	3.96	4.5
21	4.48	4.34	5.46	5.91	8.02	8.14	5.38	4.28	3.94	4.47
22	4.31	4.32	5.36	5.92	7.98	8.0	5.33	4.16	3.94	4.46
23	4.26	4.42	5.3	6.05	8.1	7.84	5.38	4.07	3.93	4.48

Daily gage height, in feet, of Animas River near Farmington, N. Mex., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
24	4.24	4.58	5.2	6.3	8.35	7.9	5.3	3.96	3.92	4.47
25	4.26	4.75	5.16	6.13	8.54	7.84	5.2	3.91	4.04	4.46
26	4.24	4.84	5.23	6.12	8.58	7.72	5.14	3.92	4.55	4.4
27	4.4	4.75	5.33	6.04	8.63	7.72	5.06	4.05	4.4	4.36
28	4.39	4.68	5.4	6.26	8.38	7.7	5.06	4.04	4.38	4.35
29	4.39	.....	5.29	6.49	8.02	7.59	5.09	3.96	4.47	4.34
30	4.36	.....	5.3	6.75	7.56	7.48	6.23	3.91	6.5	4.33
31	4.34	.....	5.3	.....	7.75	.....	6.4	3.88	.....	4.33

Station rating table for Animas River near Farmington, N. Mex., from October 20, 1904, to May 16, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.20	125	5.00	450	5.80	1,145	6.60	2,400
4.30	150	5.10	510	5.90	1,265	6.70	2,580
4.40	177	5.20	580	6.00	1,385	6.80	2,760
4.50	208	5.30	655	6.10	1,530	6.90	2,940
4.60	243	5.40	735	6.20	1,700	7.00	3,120
4.70	287	5.50	825	6.30	1,870	7.10	3,300
4.80	337	5.60	925	6.40	2,040	7.20	3,485
4.90	390	5.70	1,030	6.50	2,220	7.30	3,670

NOTE.—The above table is applicable only for open-channel conditions. It is based on 7 discharge measurements made after October 25, 1904, and is well defined.

Station rating table for Animas River near Farmington, N. Mex., from May 17 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	65	4.90	570	6.10	1,665	7.60	4,560
3.80	95	5.00	630	6.20	1,800	7.80	5,055
3.90	125	5.10	695	6.30	1,945	8.00	5,575
4.00	155	5.20	765	6.40	2,100	8.20	6,135
4.10	190	5.30	840	6.50	2,265	8.40	6,735
4.20	225	5.40	920	6.60	2,435	8.60	7,370
4.30	265	5.50	1,005	6.70	2,615	8.80	8,025
4.40	310	5.60	1,095	6.80	2,800	9.00	8,700
4.50	355	5.70	1,195	6.90	2,995	9.20	9,380
4.60	405	5.80	1,300	7.00	3,200	9.40	10,080
4.70	455	5.90	1,415	7.20	3,630	9.60	10,740
4.80	510	6.00	1,535	7.40	4,085		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is well defined between gage heights 3.9 feet and 5.8 feet.

Estimated monthly discharge of Animas River near Farmington, N. Mex., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	239	135	176	10,820
February	358	95	186	10,330
March	988	402	695	42,730
April	2,670	595	1,338	79,620
May	7,468	1,666	3,962	243,600
June	11,250	4,273	7,655	455,500
July	3,901	669	1,448	89,030
August	1,574	119	534	32,830
September	2,265	83	275	16,360
October	2,100	278	576	35,420
The period				1,016,000

LA PLATA RIVER AT HESPERUS, COLO.

This station was established June 14, 1904, in connection with investigations relating to the La Plata project in New Mexico. It is located at the highway bridge on the west side of Hesperus, Colo.

The channel is straight for about 50 feet above and below the station. Both banks are low and covered with brush and scattered trees, but neither is liable to overflow. The bed of the stream is composed of large and small cobblestones, but is not permanent. A small island above the bridge, dead water at low stages, and a tortuous channel below the bridge affect the accuracy of meter measurements at the bridge. The current is swift. The fall of the river, according to levels run by the La Plata Ditch Company for about 10 miles, is 135 feet per mile. Gage heights range from 0.8 foot to 3.5 feet.

Discharge measurements are made by wading at suitable points along the stream at low stages, as the conditions at the bridge are at some stages unfavorable to careful gagings. At high stages measurements are made from the wooden wagon bridge on the west side of Hesperus. The initial point for soundings is a nail driven into the downstream side of the wagon bridge over the south face of the north abutment.

The gage was read twice daily during 1905 by Fred Harrison. The original gage was a 4-foot board graduated from zero to 3.9 feet. This gage was spiked to the upstream end of the south face of the north abutment, with the zero mark resting on the bed of the river. The bench mark is a nail driven horizontally into the west face of a 12-inch cottonwood tree about 8 inches above the ground, about 75 feet northeast of the gage rod, on the right bank of the river; elevation, 9.15 feet above the zero of the gage. On account of the boiling action of the water at this gage, a new staff gage was installed on April 26, 1905. The new gage is graduated from zero to 5.2 feet and is spiked in a vertical position to the south face of the north abutment on the downstream side of the bridge. The datum of the new gage is not the same as that of the old, being 8.09 feet below the above bench mark.

On August 20, 1905, it was found necessary to transfer this gage to the north face of the south abutment downstream side of the bridge where it is now located. Elevation of gage datum same as that last described, viz, 8.09 feet below the bench mark.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 195-196.

Discharge measurements of La Plata River at Hesperus, Colo., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 26	M. C. Hinderlider	29	35	2.86	1.20	100
July 4	O. H. Timmerman	29	32	3.94	1.70	126
July 4	do	29	33	3.85	1.70	127
July 15	do	29	19	2.29	1.25	44
July 17	do	29	16	2.60	1.15	42
July 29	do	29	21	2.90	1.31	61
August 5	do	29	19	2.39	1.28	45
August 29	do	23	11	1.51	.95	16
September 4	do	16	28	.96	1.00	27
September 30	do	29	24	2.67	1.70	63
September 30	do	29	21	2.53	1.55	54

NOTE.—Gage heights refer to datum of April 26, 1905.

Daily gage height, in feet, of La Plata River at Hesperus, Colo., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.
1		1.92	2.7	1.9	1.25	0.92	1.32	0.92	1.18
2		1.88	2.85	1.9	1.2	.92	1.22	.9	1.3
3		1.62	2.85	1.75	1.2	.92	1.18	.9	1.1
4		1.5	3.15	1.68	1.18	1.0	1.18	.9	1.0
5		1.3	2.85	1.65	1.18	.92	1.18	.9	1.0
6		1.25	2.8	1.55	1.18	.92	1.18	.9	.95
7		1.22	2.9	1.48	1.15	.92	1.12	.95	.9
8		1.5	3.1	1.45	1.1	.92	1.12	.88	.9
9		1.48	2.9	1.35	1.02	.92	1.1	.85	.85
10		1.32	2.9	1.35	1.02	.92	1.1	.85	.85
11		1.38	2.8	1.3	1.02	.92	1.1	.85	.85
12		1.4	2.85	1.22	1.02	.92	1.1	.9	.85
13		1.4	2.8	1.22	1.0	.92	1.1	.9	.88
14		1.45	2.95	1.22	1.0	.92	1.1	.85	.88
15		1.68	3.3	1.2	1.0	.92	1.1	.85	.85
16		1.9	3.0	1.18	.98	.9	1.1	.85	.85
17		2.0	2.9	1.18	.98	.9	1.05	.85	.82
18		2.18	2.75	1.12	.92	.9	1.0	.9	.8
19		2.45	2.5	1.12	.92	.9	1.0	.8	.8
20		2.15	2.55	1.15	.92	.9	1.0	.8	.8
21		2.25	2.45	1.15	.92	.9	1.0	.85	.8
22		2.6	2.45	1.15	.92	.9	1.0	.9	.75
23		2.35	2.45	1.12	.92	.9	1.0	.92	.75
24		2.45	2.35	1.15	.92	.9	1.0	1.05	.7
25		2.65	2.35	1.1	.92	.9	1.0	1.1	.7
26	1.35	2.85	2.35	1.1	.92	.9	1.0	1.1	.95
27	1.38	2.4	2.25	1.12	.92	.9	.95	1.12	.78
28	1.6	2.3	2.15	1.1	.92	.9	.95	1.15	.5
29	1.65	2.3	2.05	1.32	.92	1.92	.95	1.1	.5
30	1.78	2.4	2.0	1.3	.92	1.55	.92	1.15	.5
31		2.65		1.3	.92		.9		.45

NOTE.—Gage heights refer to datum of April 26, 1905.

LA PLATA RIVER NEAR LA PLATA, N. MEX.

This station was established June 1, 1905, in connection with investigations relating to the La Plata project. It is located on the single-span wooden highway bridge 1 mile southeast of La Plata post-office, N. Mex., in sec. 3, T. 31, R. 13 W., below all points of diversion.

The channel is straight for 50 feet above the bridge, beyond which it bends to the right; below the bridge it is straight for 300 feet. The left bank is well defined but is liable to overflow at high stages. During high water the right bank overflows below the bridge but does not overflow above. Both banks are lined with sagebrush and willows. There is but one channel at all stages. Gage heights range from 1 foot to 4.5 feet. At gage height of 1 foot the river is dry.

Discharge measurements are made from the downstream side of the bridge.

The gage, which was read twice each day during 1905 by Frank Williams, is a vertical staff graduated from 3 to 10.1 feet, spiked to the northwest corner of the east abutment of the bridge. The 3-foot mark rests on the bed of the stream and the 9.4-foot mark is even with the surface of the bridge floor. The gage is referred to bench marks as follows: (1) The head of a 20-penny spike driven vertically into the top of the second log from the bottom at the northeast corner of Mr. Williams's house; elevation, 21.37 feet above the zero of the gage. (2) A nail driven into the spur root on the south side of a cottonwood tree southeast of house; elevation, 19.47 feet above the zero of the gage.

Discharge measurements of La Plata River near La Plata, N. Mex., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 25	M. C. Hinderlider	36	107	5.22	4.40	599
July 7	O. H. Timmerman				1.10	[a] 3
July 10	do					[a] 4
July 26	do					[a] 2.0

[a] Estimated.

Daily gage height, in feet, of La Plata River near La Plata, N. Mex., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.49	2.32	(a)	(a)	4.11	(a)	1.3
2		3.78	1.84	(a)	(a)	3.86	(a)	1.3
3		3.92	1.46	(a)	(a)	3.62	(a)	1.3
4		4.01	1.09	(a)	(a)	3.08	(a)	1.3
5		4.26	1.14	(a)	(a)	1.74	1.52	1.3
6		3.42	1.09	(a)	(a)	1.14	(a)	1.3
7		4.32	1.09	(a)	(a)	(a)	(a)	1.2
8		4.51	1.14	(a)	(a)	(a)	(a)	1.2
9		3.72	1.14	(a)	(a)	(a)	(a)	1.2
10		3.48	1.09	(a)	(a)	(a)	(a)	1.2
11		3.77	1.09	(a)	(a)	(a)	(a)	1.2
12		3.67	1.09	(a)	(a)	(a)	(a)	1.2
13		4.36	1.09	(a)	(a)	(a)	(a)	1.2
14		3.47	(a)	(a)	(a)	(a)	(a)	1.2
15		3.57	(a)	(a)	(a)	(a)	(a)	1
16		3.47	(a)	(a)	(a)	(a)	(a)	1.2

[a] Standing in pools.

Daily gage height, in feet, of La Plata River near La Plata, N. Mex., for 1905—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
17		3.37	(a)	(a)	(a)	(a)	(a)	1.2
18		3.27	(a)	(a)	(a)	(a)	(a)	1.2
19		3.22	1.44	(a)	(a)	(a)	(a)	1.2
20		3.07	(a)	(a)	(a)	(a)	(a)	1.2
21		2.98	(a)	(a)	(a)	(a)	(a)	1.2
22		2.83	(a)	(a)	(a)	(a)	(a)	1.2
23		2.79	(a)	(a)	(a)	(a)	(a)	1.2
24		2.6	(a)	(a)	(a)	(a)	(a)	1.2
25	4.33	2.46	(a)	(a)	(a)	(a)	1.20	1.2
26	4.28	2.49	1.84	(a)	(a)	(a)	(a)	1.2
27	3.76	2.42	1.39	(a)	(a)	(a)	1.48	1.2
28	3.77	2.42	1.19	(a)	(a)	(a)	1.32	1.2
29	3.37	2.22	1.09	(a)	4.4	(a)	1.3	1.2
30	3.2	2.22	1.09	(a)	4.36	(a)	1.3	1.2
31	3.28		(a)			(a)		1.2

[a] Standing in pools.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the San Juan basin in 1905:

Miscellaneous discharge measurements made in San Juan River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
July 17	Boyle ditch	Hesperus, Colo	4	3.4	3.59	12.2
September 2	do	do		1.5	1.00	1.5
October 4	do	do				.2
September 18	do	Kline, Colo				.00
July 17	Brown Bros. ditch	Hesperus, Colo				.3
September 18	do	do		1.5	1.00	1.5
August 10	Enterprise ditch	La Plata, Colo				(a)
September 18	Fort Lewis ditch No. 1	Fort Lewis, Colo		2.0	1.00	[b] 2
Do	Fort Lewis ditch No. 2	do		1.0	1.00	[b] 1
July 17	Fort Lewis ditch	Hesperus, Colo		.8	1.00	.8
July 18	Freed ditch	Kline, Colo				(a)
September 18	do	do				(a)
Do	Green canal	do				(a)
July 17	H. and H. ditch	Hesperus, Colo	4.7	4.2	1.02	4.3
September 18	do	do		2.0	1.00	[b] 2
July 17	Hay Gulch ditch	do	5	5.8	2.48	14.41
September 2	do	do	4	3.2	1.91	6.1
September 7	do	do	5.6	3.01	5.28	15.92
September 30	do	do	5.6	5.0	4.42	22.1
July 18	Helton ditch	Kline, Colo	4	2.0	1.10	2.2
September 18	do	do				(a)
July 17	Indian ditch	Hesperus, Colo		1.0	.75	.8
July 17	Kellar ditch	do				(a)
April 26	La Plata canal	do				8.8
July 4	do	do	10	9.2	.66	6.1
July 15	do	do	4	2.8	2.29	6.4

[a] Dry. [b] Estimated.

Miscellaneous discharge measurements made in San Juan River drainage basin in 1905—Continued.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Discharge
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
July 17	La Plata canal	Hesperus, Colo	4	1.6	1.75	2.8
July 29	do	do	4	2.4	2.42	5.8
August 5	do	do	4	1.6	1.06	1.7
September 2	do	do	4	2.4	1.21	2.9
September 4	do	do	4	2.0	1.35	27.1
July 15	La Plata and Cherry Creek ditch.	do	4.8	3.4	5.68	19.3
September 2	do	do		2.0	1.0	[a] 2.0
September 30	do	do				[b]
October 4	do	do				[b]
April 25	Lightner Creek	Durango, Colo				17.7
July 14	do	do				[a] 6.5
July 31	do	do				[a] 6
August 7	do	do				[a] 7
September 9	do	do				[a] 9
September 15	do	do				[a] 7
September 20	do	do				[a] 6
October 1	do	do				[a] 7
October 4	Placer ditch	Hesperus, Colo				[b]
July 15	Parrott ditch	do				[b]
September 16	do	do				[b]
October 4	do	do				[b]
September 30	Parrott City canal	Parrott City, Colo				[b]
September 2	Ramott canal	Hesperus, Colo				[b]
July 18	Revival ditch		2	1.0	1.00	1.0
July 17	Short Line ditch	Hesperus, Colo	4	1.2	.92	1.1
September 18	do	Kline, Colo				[b]
July 17	Slate ditch		8	4.8	2.17	10.4
July 18	Stinebaugh ditch					[b]
September 5	Steinmegger canal	Hesperus, Colo				[b]
July 17	Trainor ditch	Kline, Colo				[a] .5
September 18	do	do				[b]
Do	Ute Indian ditch	Fort Lewis, Colo				[b]
July 18	Warren ditch					[b]

[a] Estimated. [b] Dry.

LITTLE COLORADO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The country drained by the Little Colorado River consists of a high plateau with an elevation over 4,000 feet above sea level, extending from the Continental Divide in northwestern New Mexico westward to the San Francisco Mountains in Arizona, and from the Grand Canyon of the Colorado southward to the Mogollon Mesa. The greater part of this plateau is composed of rolling plains with a few feet of soil at the surface underlain by rock. Through this plateau the river winds northwestward to its junction with the great Colorado.

The run-off from approximately 6,000 square miles of the drainage area finds its way into the Little Colorado above the mouth of Rio Puerco, the largest tributary which joins the main stream 2 miles above the town of Holbrook, Ariz. Both the Little Colorado and the Rio Puerco are flashy streams, seldom clear even during low stages. They have shifting, sandy bottoms, and when not confined in canyons the stream beds are wide with abrupt earth banks. The discharge fluctuates greatly, being insignificant in dry seasons. The floods are short and violent and carry large quantities of silt in suspension.

LITTLE COLORADO RIVER AT WOODRUFF, ARIZ.

This station was established March 16, 1905. It is located about 100 yards below the crossing of the Holbrook-Winslow wagon road and one-fourth mile below the Woodruff dam.

The channel is straight for 300 feet above and 100 feet below the station. The banks are high, with some brush, and neither is liable to overflow. The bed of the stream is composed of sand. The current is swift at high and medium stages of water.

Discharge measurements are made by means of a cable, car, and tag wire. The initial point for soundings is the iron hook on the chain connecting the cable with anchorage on left or west bank of stream.

The gage is observed twice each day by R. L. Newman. The original gage was a combined vertical and inclined rod located on the right or east bank of the stream about 60 feet below the measuring section. This gage was destroyed on May 3, 1905, by high water, caused by the breaking of the St. John and Woodruff dams. It was replaced on May 6, 1905, with a temporary gage, which was used until July 30, 1905, when a permanent gage was installed at the original location. The bench mark is a nail driven into a 6-inch cottonwood tree 23 feet N. 10° W. from east end of gage. The original elevation of this bench mark was 19.40 feet above the zero of the gage. This tree was so bent over by the rush of water on May 3 that the bench mark is about 0.05 foot lower than it was originally. The zero of the gage established July 30, 1905, was set 13.03 feet below the elevation of the bench mark, or approximately 13.07 feet below the original elevation. On July 30, 1905, the water stood at 5.0 feet on the temporary gage set by the observer May 6, and registered 0.8 foot at the same time on the new permanent gage.

Discharge measurements of Little Colorado River at Woodruff, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 22	W. A. Farish	9.25	736	September 27	R. L. Newman	2.1	137
May 1	do	7.4	480	September 28	do	1.4	66
July 31	Newman and Farish.	3.05	459	September 29	do	1.7	178
August 3	R. L. Newman	.8	54	September 30	do	1.3	80
August 4	do	.5	28	October 1	do	1.0	63
August 6	do	.3	18.1	October 3	do	.8	32
August 7	do	.5	30	October 4	do	0.8	30
August 8	do	.8	49	October 6	do	0.7	35
August 9	do	.5	45	October 7	do	0.7	35
August 10	do	.5	53	October 8	do	0.7	22
August 11	do	1.3	201	October 10	do	0.6	15.4
August 13	do	.4	94	October 12	do	0.6	15.1
August 14	do	.5	58	October 13	do	6.6	13.8
August 15	do	.4	77	October 14	do	0.6	11.5
August 16	do	.3	44	October 16	do	0.5	16
August 17	do	.3	46	October 17	do	0.5	14.5
August 18	do	.3	12	October 19	do	0.5	14.6
August 19	do	.1	6.2	October 20	do	0.5	15.1
August 22	do	.0	9.3	October 21	do	0.5	14.7
August 24	do	1.3	132	October 23	do	0.4	12.8
August 25	do	1.1	99	October 24	do	0.4	12.7
August 27	do	3.7	342	October 25	do	0.4	13.4
August 29	do	.5	30	October 26	do	0.4	12.5
August 31	do	.5	17.4	October 27	do	0.4	13.6
September 1	do	.3	13.1	October 28	do	0.4	13.7
September 3	do	.3	17.7	October 30	do	0.4	11.6
September 4	do	.2	11.4	October 31	H. S. Reed	0.4	14.4
September 6	do	6	1,216	October 31	do	0.4	14
September 7	do	1.4	131	November 1	R. L. Newman	6.4	11
September 9	do	1.4	114	November 7	do	1.0	39
September 11	do	.5	33	November 8	do	1.0	38
September 12	do	.5	28	November 9	do	3.35	249
September 13	do	.3	17.8	November 10	do	1.4	52
September 14	do	.3	19	November 11	do	1.1	38
September 16	do	.2	13.7	November 20	do	.7	25
September 20	do	.1	8	November 21	do	1.5	67
September 21	do	.1	8.3	November 22	do	2.0	130
September 23	do	.1	8.7	November 23	do	2.7	172
September 24	do	4.75	880	November 24	do	1.2	46
September 25	do	3.7	657	November 25	do	1.0	33

Daily gage height, in feet, of Little Colorado River at Woodruff, Ariz., for 1905.

Day.	Mar	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.9	7.5	3.65	2,0	2.4	0.3	1.1	0.4	1.7
2	.....	8.05	6.95	3.6	2.0	1.55	.6	.95	.4	1.55
3	.....	11.2	19.65	3.5	2.0	.8	.25	.8	.4	1.45
4	.....	11.1	11.5	3.45	1.95	.5	.75	.75	4.0	1.3
5	.....	12.4	9.75	3.4	1.9	.3	.75	.7	2.2	1.3
6	.....	12.8	8.75	3.35	1.9	.3	2.5	.7	1.15	1.2
7	.....	12.15	8.0	3.25	1.9	.5	1.7	.7	.9	1.05
8	.....	11.4	7.5	3.85	1.9	.65	1.4	65	1.65	.8
9	.....	10.15	7.0	3.95	2.8	.6	1.35	.6	2.65	.7
10	.....	10.0	6.5	3.75	2.7	.5	.95	.6	1.4	.7
11	.....	8.25	7.25	3.45	2.6	.9	.6	.6	1.1	.7
12	.....	12.3	7.55	3.2	2.5	.55	.5	.6	1.0	.55
13	.....	13.4	5.95	3.2	2.4	.45	.35	.6	1.0	.75
14	.....	9.2	5.4	3.2	2.3	.4	.3	.6	.9	.6
15	.....	8.65	5.35	3.15	2.25	.4	.3	.5	.85	.5
16	7.4	7.4	4.95	3.1	2.0	.3	.2	.5	.8	.5
17	10.3	6.7	4.75	3.05	1.95	.3	.2	.5	.8	.5
18	10.45	6.3	4.6	3.0	1.9	.25	.2	.5	.8	.5
19	9.75	5.9	4.5	3.0	2.1	.1	.1	.5	.75	.5
20	9.45	5.45	4.45	2.5	3.6	.0	.1	.5	.7	.6
21	12.4	5.65	4.4	2.0	2.0	.0	.1	.5	.7	.6
22	8.05	5.25	4.3	2.0	1.95	.0	.1	.5	1.35	.6
23	7.85	5.3	4.35	2.0	2.05	.0	.15	.4	2.3	.55
24	7.35	8.9	4.25	2.0	2.0	.65	3.95	.4	1.25	.5
25	7.35	11.95	4.2	2.0	1.9	1.15	4.55	.4	1.1	.4
26	6.95	18.55	4.1	2.0	2.15	.8	4.0	.4	1.0	.4
27	6,3	13.55	4.1	2.0	2.05	2.85	1.9	.4	21.9	.4
28	6.3	9.9	4.0	2.0	2.1	1.35	1.35	.4	7.75	.4
29	6.4	8.05	4.0	2.0	5.2	0.5	1.6	.4	5.5	.35
30	6.7	7.85	4.0	2.0	7.25	.5	1.4	.4	2.0	.3
31	5.7	.....	3.8	.....	4.75	.5	.....	.4	.....	.3

Daily discharge, in second-feet, of Little Colorado River at Woodruff, Ariz., for 1905.

Day.	Mar.	Apr.	May.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	320	492	317	13	80	12	[illegible]
2	.....	560	432	145	32	53	12	[illegible]
3	.....	1,028	2,296	54	15	32	12	[illegible]
4	.....	1,013	.....	28	47	26	323	[illegible]
5	.....	1,208	.....	18	47	22	126	[illegible]
6	.....	1,268	.....	18	948	35	42	[illegible]
7	.....	1,170	.....	29	190	35	36	[illegible]
8	.....	1,058	.....	38	122	18	80	[illegible]
9	.....	870	.....	53	80	15	167	[illegible]
10	.....	848	.....	53	65	15	52	[illegible]
11	.....	589	.....	122	40	15	38	[illegible]
12	.....	1,193	.....	93	28	15	36	[illegible]
13	.....	1,358	.....	100	20	14	36	[illegible]
14	.....	728	.....	49	19	12	32	[illegible]
15	.....	646	.....	47	19	15	31	[illegible]
16	481	481	.....	44	14	15	29	[illegible]
17	893	404	.....	46	14	15	29	[illegible]
18	916	362	.....	10	14	15	29	[illegible]
19	810	320	.....	6	8	15	26	[illegible]
20	766	274	.....	5	8	15	25	[illegible]
21	1,208	294	.....	5	8	15	25	[illegible]
22	562	254	.....	9	8	15	71	[illegible]
23	534	259	.....	9	10	13	135	[illegible]
24	475	683	.....	54	684	13	44	[illegible]
25	475	1,140	.....	106	868	13	36	[illegible]
26	432	2,030	.....	64	848	13	33	[illegible]
27	362	1,380	.....	166	234	13	10,000	[illegible]
28	362	830	.....	46	118	13	2,960	[illegible]
29	372	561	.....	30	155	13	1,735	[illegible]
30	404	534	.....	23	92	13	85	[illegible]
31	299	.....	.....	17	.....	13	.....	[illegible]

NOTE.—Owing to no measurements being made during May, June, and July, no estimates have been made. Discharge obtained by indirect method.

Estimated monthly discharge of Little Colorado River at Woodruff, Ariz., for 1905.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 16–31	1,208	299	584	18,530	0.097	[illegible]
April	2,030	254	789	46,950	.132	.147
August	317	5	58.2	3,579	.0097	.011
September	948	8	159	9,461	.026	.029
October	80	12	20.1	1,236	.0034	[illegible]
November	10,000	12	543	32,310	.090	[illegible]
December	72	25	37.4	2,300	.0062	[illegible]
The period	.....	.....	.....	114,400	.....	.....

LITTLE COLORADO RIVER AT HOLBROOK, ARIZ.

This station was established March 17, 1905. It is located at the county bridge across Little Colorado River at Holbrook, Ariz.

The channel is straight for about 300 feet both above and below the station. A stone jetty along the side of the wagon road forms the right bank; the left bank is clean and does not overflow. The bed of the stream is sand to an average depth of 3 to 5 feet, and is very unstable. The entire flow of the river passes under the bridge; but as the section is wide the current does not always flow at right angles to the bridge.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the bridge abutment on west bank of stream. Soundings are taken at each of the floor beams.

The gage, which was read twice each day during 1905 by Mrs. Anna Connor, is a staff fastened in an upright position to the downstream face of the first pier from the west bank. The gage is referred to bench marks as follows: (1) The corner of the top of the bridge pier to which the gage is fastened; elevation, 11.80 feet above the zero of the gage. (2) The bottom outside edge of the bridge chord; elevation, 12.73 feet above the zero of the gage.

Discharge measurements of Little Colorado River at Holbrook, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
March 20	W. A. Farish	5.9	942	September 18	R. L. Newman	2.9	11
March 21	do	6.6	1,380	September 19	do	2.9	11
March 21	do	6.35	1,139	September 22	do	2.9	12
April 30	do	4.6	923	September 25	do	3.95	500
May 2	do	4.7	568	September 27	do	3.6	174
May 24	E. C. Murphy	3.48	175	September 30	do	4.0	464
July 30	W. A. Farish	4.4	1,215	October 2	do	3.3	96
August 1	R. L. Newman	3.5	176	October 4	do	3.3	87
August 1	do	3.5	170	October 6	do	3.3	79
August 5	do	3.0	58	October 8	do	3.2	29
August 8	do	3.0	43	October 11	do	3.0	15
August 11	do	3.2	55	October 13	do	3.0	22
August 12	do	3.3	174	October 16	do	3.0	27
August 15	do	3.0	33	October 18	do	3.1	25
August 17	do	3.1	95	October 20	do	3.0	20
August 21	do	2.9	64	October 23	do	3.1	25
August 25	do	3.2	60	October 25	do	3.0	18
August 27	do	3.8	714	October 27	do	3.0	20
August 30	do	3.3	116	October 30	H. S. Reed	3.0	11
August 31	do	2.9	47	November 1	R. L. Newman	3.0	11
September 2	do	3.3	81	November 8	do	4.3	624
September 4	do	3.3	59	November 9	do	4.25	412
September 6	do	5.5	3,444	November 13	do	3.3	49
September 8	do	3.6	124	November 18	do	3.1	40
September 10	do	3.5	81	November 22	do	3.7	225
September 11	do	3.2	46	November 24	do	4.0	112
September 13	do	3.1	11	November 29	do	3.9	479
September 15	do	2.9	15				

Daily gage height, in feet, of Little Colorado River at Holbrook, Ariz., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.45	4.78	3.4	3.0	3.5	3.3	3.6	3.1	3.25
2	.....	5.9	4.72	3.35	3.0	3.5	3.45	3.45	3.1	3.5
3	.....	5.9	6.2	3.3	2.9	3.4	3.3	3.3	3.1	3.2
4	.....	6.25	.....	3.2	2.8	3.3	3.1	3.3	4.25	3.2
5	.....	6.8	.....	3.2	2.8	3.15	4.2	3.3	3.9	3.2
6	.....	6.9	.....	3.0	2.8	3.15	4.8	3.3	3.5	3.2
7	.....	6.45	.....	3.0	2.8	2.95	4.15	3.3	3.2	3.2
8	.....	5.85	.....	3.0	2.8	3.3	3.7	3.3	3.7	3.15
9	.....	5.9	.....	3.2	2.8	3.05	3.7	3.3	4.85	3.1
10	.....	5.4	5.8	3.4	2.8	3.2	3.7	3.2	3.6	3.1
11	.....	5.7	5.55	3.3	2.8	3.45	3.4	3.2	3.6	3.15
12	.....	6.45	4.9	3.2	2.8	3.55	3.3	3.2	3.45	3.2
13	.....	6.15	4.25	3.2	2.8	3.2	3.0	3.2	3.4	3.3
14	.....	5.35	4.0	3.2	2.8	3.2	3.0	3.1	3.4	3.4
15	.....	5.3	3.9	3.2	2.8	3.1	3.0	3.1	3.3	3.2
16	.....	4.75	3.85	3.2	3.5	3.25	3.0	3.1	3.3	3.1
17	6.1	4.55	3.8	3.2	3.05	3.15	3.0	3.1	3.2	3.1
18	6.25	4.6	3.8	3.2	3.0	3.0	3.0	3.1	3.2	3.1
19	5.95	4.6	3.7	3.2	3.0	2.9	3.0	3.1	3.1	3.1
20	6.05	4.65	3.7	3.2	4.05	2.9	3.0	3.1	3.1	3.1
21	6.4	4.6	3.95	3.2	3.25	2.9	3.0	3.1	3.1	3.1
22	5.5	4.7	3.9	3.2	2.9	3.0	3.0	3.1	4.55	3.15
23	5.3	4.6	3.65	3.15	3.0	2.9	3.0	3.1	4.25	3.2
24	5.55	6.45	3.4	3.1	3.0	2.9	4.9	3.1	4.0	3.2
25	5.45	6.8	3.4	3.1	3.0	2.9	4.45	3.1	3.7	3.2
26	5.45	7.35	3.4	3.1	3.0	3.75	4.8	3.1	3.5	3.2
27	5.42	5.55	3.4	3.0	3.0	4.1	4.1	3.1	8.55	3.4
28	5.42	5.8	3.4	3.0	2.8	3.5	3.5	3.1	5.75	3.4
29	5.3	4.65	3.4	3.0	3.25	3.5	3.7	3.0	4.05	3.45
30	5.22	4.7	3.4	3.0	4.5	3.5	4.0	3.0	3.80	3.4
31	5.22	.....	3.4	.....	4.05	3.0	.....	3.0	.....	3.4

Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	792	578	145	44	170	130	220	30	115
2	.....	940	558	132	44	170	160	140	30	325
3	.....	940	1,055	120	22	145	75	91	30	95
4	.....	1,081	.....	88	5	120	30	87	410	95
5	.....	1,570	.....	88	5	77	280	83	295	95
6	.....	1,665	.....	44	5	77	1,480	79	160	95
7	.....	1,238	.....	44	5	33	545	75	60	95
8	.....	923	.....	44	5	120	175	75	225	70
9	.....	940	.....	88	5	55	175	75	1,620	45
10	.....	776	905	145	5	88	175	39	195	45
11	.....	872	824	120	5	125	85	39	195	70
12	.....	1,238	616	88	5	310	50	39	145	95
13	.....	1,035	408	88	5	100	15	39	130	140
14	.....	760	328	88	5	85	15	29	130	205
15	.....	744	296	88	5	50	15	29	95	95
16	.....	568	280	88	170	115	15	29	95	45

Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1905—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
17	1,015	504	264	88	55	115	15	29	60	45
18	1,081	520	264	88	44	80	15	29	60	45
19	958	520	232	88	44	64	15	29	30	45
20	995	536	232	88	344	64	15	29	30	45
21	1,190	520	312	88	99	64	15	29	30	45
22	808	552	296	88	22	80	15	29	860	70
23	744	520	216	77	44	64	15	29	412	95
24	824	1,238	145	66	44	64	1,760	29	325	95
25	792	1,570	145	66	44	64	875	29	225	95
26	792	2,075	145	66	44	310	1,480	29	160	95
27	782	824	145	44	44	1,200	520	29	20,180	205
28	782	905	145	44	5	430	155	29	7,295	205
29	744	536	145	44	99	340	265	19	1,000	270
30	718	552	145	44	488	215	465	19	260	205
31	718	.....	145	.....	344	60	.....	19	.....	205

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of Little Colorado River at Holbrook, Ariz., for 1905.

[Drainage area, 17,630 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
March 17-31	1,190	718	863	25,680	0.049	0.027
April	2,075	504	915	54,450	.052	.058
May (25 days)	1,055	145	353	17,500	.020	.019
June	145	44	82.6	4,915	.0047	.0052
July	488	5	67.9	4,175	.0039	.0045
August	1,200	33	163	10,020	.0092	.011
September	1,760	15	302	17,970	.017	.019
October	220	19	50.7	3,117	.0029	.0033
November	20,180	30	1,150	68,960	.066	.074
December	325	45	113	6,948	.0064	.0074
The period	.....	.....	.....	213,700	.....	.....

Summary of observations of evaporation at Holbrook, Ariz., in 1905.

AUGUST.

Day.	Period (in hours) in which measured evaporation has occurred.	Amount of evaporation.	Temperature of water in pan.			Temperature of water outside pan.		
			A. M.	P. M.	Mean.	A. M.	P. M.	Mean.
2	12 hours	0.06	.....	72	.....	.....	72	.....
3	24 hours	.19	66	77	71.5	66	77	71.5
4	do	.24	68	77	72.5	69	78	73.5
5	do	.26	78	79	78.5	71	79	[a] 75.0
6	do	.27	71	80	75.5	71	80	75.5
7	do	.29	72	78	75.0	72	79	75.5
8	do	.23	74	78	76.0	73	78	75.5
9	do	.26	71	72	71.5	70	72	71.0
10	do	.29	70	75	72.5	70	75	72.5
11	do	.12	68	77	72.5	69	77	[b] 73.0
12	do	.24	69	78	73.5	70	78	74.0
13	do	.25	69	76	72.5	70	76	73.0
14	do	.29	69	77	73.0	69	77	73.0
15	do	.24	70	77	73.5	71	77	74.0
16	do	.23	70	78	74.0	70	77	73.5
17	do	.19	70	78	74.0	71	78	74.5
18	do	.26	70	78	74.0	71	77	74.0
19	do	.21	69	77	73.0	70	78	74.0
20	do	.24	70	76	73.0	70	77	73.5
21	do	.23	69	76	72.5	70	77	73.5
22	do	.31	70	74	72.0	71	75	[c] 73.0
23	do	.10	70	75	72.5	71	75	73.0
24	do	.20	70	75	72.5	71	75	[b] 73.0
25	do	.09	70	76	73.0	70	75	72.5
26	do	.21	71	78	74.5	71	78	74.5
27	do	.19	71	71	71.0	71	71	71.0
28	do	.22	70	78	74.0	71	77	74.0
29	do	.16	71	81	76.0	71	80	75.5
30	do	.23	72	76	74.0	72	76	74.0
31	do	.30	72	76	74.0	72	76	74.0

[a] Slight wind. [b] Rain. [c] High wind.

Summary of observations of evaporation at Holbrook, Ariz., in 1905—Continued.

SEPTEMBER.

Day.	Period (in hours) in which measured evaporation has occurred.	Amount of evaporation.	Temperature of water in pan.			Temperature of water outside pan.		
			A. M.	P. M.	Mean.	A. M.	P. M.	Mean.
1	24 hours	0.19	69	76	72.5	70	76	73.0
2	do	.24	79	78	78.5	70	78	74.0
3	do	.26	69	71	70.0	69	71	70.0
4	do	.06	69	70	69.5	68	70	69.0
5	do	.09	66	66	66.0	67	66	66.5
6	do	.11	64	70	67.0	65	70	67.5
7	do	.14	64	73	68.5	65	72	68.5
8	do	.18	65	71	68.0	65	71	68.0
9	do	.18	65	73	69.0	65	73	69.0
10	do	.17	64	72	68.0	65	70	67.5
11	do	.16	62	73	67.5	63	72	67.5
12	do	.22	65	71	68.0	65	71	68.0
13	do	.21	65	72	68.5	66	72	69.0
14	do	.21	66	72	69.0	66	72	69.0
15	do	.21	61	73	67.0	61	73	67.0
16	do	.27	65	72	68.5	65	72	[a] 68.5
17	do	.22	63	70	66.5	63	70	[a] 66.5
18	do	.20	65	68	66.5	65	68	66.5
19	do	.20	59	70	64.5	60	70	65.0
20	do	.18	60	69	64.5	61	70	65.5
21	do	.17	60	70	65.0	61	71	66.0
22	do	.16	61	71	66.0	62	71	66.5
23	do	.06	62	62	62.0	62	62	62.0
24	do	.0	61	65	63.0	61	65	63.0
25	do	.0	60	60	60.0	60	60	60.0
26	do	.10	61	61	61.0	62	61	61.5
27	do	.14	65	72	68.5	64	71	67.5
28	do	.09	63	61	62.0	63	61	62.0
29	do	.05	61	59	60.0	63	60	61.5
30	do	.10	55	61	58.0	56	62	59.0

[a] High wind.

Summary of observations of evaporation at Holbrook, Ariz., in 1905—Continued.

OCTOBER.

Day.	Period (in hours) in which measured evaporation has occurred.	Amount of evaporation.	Temperature of water in pan.			Temperature of water outside pan.		
			A. M.	P. M.	Mean.	A. M.	P. M.	Mean.
1	24 hours	0.08	55	67	61.0	56	66	61.0
2	do	.14	56	68	62.0	57	68	62.5
3	do	.12	59	67	63.0	59	67	63.0
4	do	.11	57	69	63.0	57	69	63.0
5	do	.12	59	70	64.5	60	69	64.5
6	do	.11	60	70	65.0	60	70	65.0
7	do	.15	59	73	66.0	61	73	67.0
8	do	.26	61	65	63.0	60	64	[a] 62.0
9	do	.16	58	64	61.0	58	64	61.0
10	do	.16	58	65	61.5	58	64	61.0
11	do	.17	58	67	62.5	58	67	62.5
12	do	.08	55	62	58.5	55	60	57.5
13	do	.14	56	58	57.0	56	58	57.0
14	do	.14	55	60	57.5	54	60	57.0
15	do	.18	55	64	59.5	54	64	59.0
16	do	.20	52	57	54.5	51	56	53.5
17	do	.19	50	55	52.5	50	54	52.0
18	do	.18	49	53	51.0	49	54	51.5
19	do	.14	50	56	53.0	49	56	52.5
20	do	.10	42	49	45.5	42	48	45.0
21	do	.08	42	62	52.0	49	59	54.0
22	do	.13	57	64	60.5	56	63	59.5
23	do	.09	52	57	54.5	52	56	54.0
24	do	.11	52	58	55.0	51	57	54.0
25	do	.14	50	59	54.5	51	58	54.5
26	do	.08	51	54	52.5	51	55	53.0
27	do	.10	48	53	50.5	49	52	50.5
28	do	.11	48	52	50.0	50	52	51.0
29	do	.16	49	59	54.0	50	57	53.5
30	do	.17	42	60	51.0	43	59	51.0
31	do	.16	41	56	48.5	42	57	49.5

[a] High wind.

Summary of observations of evaporation at Holbrook, Ariz., in 1905—Continued.

NOVEMBER.

Day.	Period (in hours) in which measured evaporation has occurred.	Amount of evaporation.	Temperature of water in pan.			Temperature of water outside pan.		
			A. M.	P. M.	Mean.	A. M.	P. M.	Mean.
1	24 hours	0.07	42	52	47.0	43	51	47.0
2	do	.00	43	59	51.0	42	57	49.5
3	do	.06	50	54	52.0	50	54	52.0
4	do	.04	51	59	55.0	51	59	55.0
5	do	.02	50	54	52.0	50	53	51.5
6	do	.03	52	50	51.0	52	50	51.0
7	do	.07	50	55	52.5	50	55	52.5
8	do	.....	51	47	49.0	51	48	49.5
9	do	.08	47	52	49.5	47	52	49.5
10	do	.07	45	48	46.5	46	48	47.0
11	do	.08	45	50	47.5	45	50	47.5
12	do	.10	47	52	49.5	47	52	49.5
13	do	.04	43	54	48.5	44	54	49.0
14	do	.06	52	51	51.5	52	51	51.5
15	do	.08	43	52	47.5	44	52	48.0
16	do	.06	47	50	48.5	47	50	48.5
17	do	.07	45	51	48.0	46	51	48.5
18	do	.06	40	52	46.0	41	52	46.5
19	do	.06	43	52	47.5	45	50	47.5
20	do	.08	49	50	49.5	49.5	50	49.5
21	do	.05	44	50	47.0	45	50	47.5
22	do	.00	45	48	46.5	45	48	46.5
23	do	.02	45	48	46.5	45	48	46.5
24	do	.07	45	48	46.5	45	48	46.5
25	do	.05	45	49	47.0	45	49	47.0
26	do	.00	50	49	49.5	50	48	49.0
27	do	.00	45	48	46.5	45	48	46.5
28	do	.10	40	49	44.5	42	49	[a] 45.5
29	do	.00	41	49	45.0	41	49	45.0
30	do	.03	40	45	42.5	40	45	42.5

[a] High wind.

Summary of observations of evaporation at Holbrook, Ariz., in 1905—Continued.

DECEMBER.

Day.	Period (in hours) in which measured evaporation has occurred.	Amount of evaporation.	Temperature of water in pan.			Temperature of water outside pan.		
			A. M.	P. M.	Mean.	A. M.	P. M.	Mean.
1	24 hours	0.08	38	48	43.0	41	48	44.5
2	do	.00	38	42	40.0	40	42	41.0
3	do	.05	40	45	42.5	40	42	41.0
4	do	.00	40	45	42.5	40	45	42.5
5	do	.04	40	45	42.5	40	45	42.5
6	do	.00	40	45	42.5	40	45	42.5
7	do	.04	40	48	44.0	40	48	44.0
8	do	.00	40	43	41.5	40	43	41.5
9	do	.00	40	42	41.0	40	42	41.0
10	do	.00	40	41	40.5	40	41	40.5
11	do	.00	35	38	36.5	34	38	36.0
12	do	.00	40	42	41	40	42	41.0
13	do	.00	40	42	41.0	40	42	41.0
14	do	.00	38	41	39.5	34	40	37.0
15	do	.00	40	43	41.5	40	43	41.5
16	do	.00	39	41	40.0	40	41	40.5
17	do	.00	39	40	39.5	40	41	40.5
18	do	.00	37	39	38.0	39	40	39.5
19	do	.00	37	39	38.0	39	40	39.5
20	do	.01	35	40	37.5	37	40	38.5
21	do	.00	35	40	37.5	36	40	38.0
22	do	.00	33	38	35.5	34	39	36.5
23	do	.00	32	34	33.0	32	34	33.0

CHEVLON FORK NEAR WINSLOW, ARIZ.

This station was established December 18, 1905. It is located 4½ miles above the mouth of the river, in sec. 34, T. 18 N., R. 17 E., 19 miles east of Winslow, Ariz.

The channel is straight for 150 feet above and below the station. The current is very swift during high water. At extreme low water the current is rather sluggish, but it has a good velocity at ordinary stage. Both banks are practically vertical cliffs about 33 feet high. A dirt bank extending about 12 feet from the base of the cliff and 3 or 4 feet high has been deposited at the foot of the cliff on the left bank. The bed is of solid rock excepting a small bank of sand on the left bank which is alternately deposited and scoured out.

Discharge measurements are made by means of a cable, car, and tagged and stay wires The initial point for soundings is the face of the eyebolt to which the tagged wire is fastened on the left bank of the stream. A secondary cable has been stretched across the river 100 feet downstream from the tagged wire for use in making float measurements at very high stages.

An automatic water stage register is placed on an overhanging platform 26.5 feet above the bed of the creek. The station is visited and the register reset once each week by R. L. Newman. The distance to the center of the first band from the top of the baseboard upon which the register sets is 5.90 feet; to the center of the second band, from the same point, 9.57 feet. The base of the register baseboard is 27.30 feet above the datum of the gage.

Discharge measurements of Chevlon Fork near Winslow, Ariz., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
November 25	H. S. Reed	5.0	1.36	0.65	1.00	0.88
December 19	do	42.0	104	.32	2.10	33.3

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Little Colorado River drainage basin during 1905:

Miscellaneous discharge measurements made in Little Colorado River drainage basin in 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 19	Chevlon Fork	Crossing of Holbrook-Winslow wagon road.	26.7	8.2	1.10	.....	9.1
August 19	do	do	26.7	7.9	1.30	0.5	11.1
August 30	do	do	25.5	13.7	.92	.7	12.6
September 10	do	do	23.6	9.9	.65	.4	6.4
September 19	do	do	26.0	7.0	.65	.5	4.5
September 29	do	do	24.0	12.7	1.34	.7	17.0
October 9	do	do	19.7	9.0	1.03	.5	9.3
October 18	do	do	20.1	9.1	1.16	.5	10.6

VIRGIN RIVER DRAINAGE BASIN.

MUDDY RIVER NEAR MOAPA, NEV.

Muddy River is a branch of the Virgin, one of the more important tributaries of the Colorado. The stream drains a long narrow strip of country in the eastern part of Lincoln County, Nev., flows southward, and joins the Virgin about 25 miles above the point where the latter stream enters the Colorado.

The gaging station was established January 1, 1904. It is located near the crossing of the San Pedro, Los Angeles and Salt Lake Railroad, about 6 miles downstream from Moapa, Nev. The station is above the Narrows and will show the amount of water available for storage at the proposed reservoir site in the Narrows.

The channel is straight for 35 feet above and below the station, and high, brush-covered banks slope up from the vertical sides of the channel. The immediate banks are low, but not liable to overflow. The bed of the stream is composed of sand and is shifting. It is covered with vegetation, which is kept grubbed out near the station. The current has a moderate velocity.

Discharge measurements are made from a footbridge 450 feet downstream from the gage. The initial point for soundings is a nail driven into the downstream side of the bridge at the right bank.

The gage, which was read twice each day during 1905 by J. V. Houghton, is a vertical staff nailed to a post driven into the right bank. The bench mark is the top of a 2-inch post driven into the ground in a willow clump 20 feet from the gage on the right bank; elevation, 9.90 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 196–197.

Daily gage height, in feet, of Muddy River near Moapa, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	3.6	2.0	2.0	2.1	1.9	1.9	2.0	1.9	2.2	2.3	2.5
2	2.2	3.6	2.0	2.2	2.0	1.9	1.9	2.0	2.0	2.2	2.4	2.5
3	2.2	3.6	2.0	2.2	2.0	1.9	1.9	2.0	1.9	2.2	2.4	2.6
4	2.2	3.6	2.0	2.2	2.0	1.9	1.9	1.9	1.95	2.2	2.4	2.6
5	2.2	3.6	2.0	2.2	1.9	2.0	1.9	1.9	1.9	2.2	2.4	2.6
6	2.2	3.6	2.0	2.2	1.9	2.0	1.9	1.9	1.9	2.2	2.4	2.7
7	2.2	3.6	2.0	2.2	2.0	2.0	1.9	1.9	1.9	2.0	2.4	2.7
8	2.2	3.6	2.0	2.2	2.0	2.0	1.9	2.0	1.9	2.0	2.4	2.7
9	2.2	3.6	2.0	2.2	2.0	2.0	1.9	2.0	2.0	2.0	2.4	2.7
10	2.2	3.4	2.0	2.3	2.0	2.0	1.9	6.5	1.9	2.0	2.4	2.8
11	2.3	3.4	2.0	3.6	2.0	1.9	1.9	5.8	1.8	2.0	2.4	2.85
12	2.3	3.3	3.0	3.8	2.0	1.9	1.9	2.5	1.8	2.0	2.4	2.8
13	2.3	3.3	3.5	3.4	2.0	1.9	1.9	2.0	1.8	1.0	2.4	2.7
14	2.3	2.7	4.0	3.4	2.0	1.9	1.7	2.0	1.9	1.9	2.5	2.7
15	2.3	2.7	4.2	3.2	2.0	1.9	1.5	2.0	2.0	1.9	2.5	2.7
16	2.3	2.6	4.4	3.2	1.9	1.9	1.2	2.0	2.0	1.9	2.4	2.7
17	2.3	2.5	4.4	2.6	1.9	1.9	3.6	2.0	2.0	1.9	2.4	2.7
18	2.5	2.5	4.2	2.4	1.9	1.9	3.5	2.0	2.0	2.0	2.4	2.7
19	2.5	2.4	4.0	2.2	1.9	1.9	3.4	2.0	2.0	2.15	2.5	2.6
20	2.45	2.3	3.5	2.1	1.9	1.9	3.0	2.0	2.0	2.2	2.5	2.6
21	2.45	2.3	3.5	2.1	1.8	1.9	3.0	1.9	1.9	2.2	2.5	2.6
22	2.45	2.2	3.0	2.1	1.8	1.9	3.0	1.9	1.9	2.2	2.5	2.6
23	2.45	2.2	2.2	2.1	1.8	1.9	2.5	1.9	1.9	2.25	2.5	2.6
24	2.45	2.1	2.2	2.15	1.8	1.9	2.3	1.9	2.0	2.3	2.5	2.6
25	2.45	2.0	2.2	2.1	1.8	1.9	2.3	2.0	2.0	2.3	2.5	2.6
26	2.45	2.0	2.1	2.1	1.8	1.9	2.0	2.0	2.0	2.3	2.5	2.6
27	2.45	2.0	2.0	2.1	1.8	1.9	2.0	2.0	2.0	2.3	2.6	2.7
28	2.45	2.0	2.0	2.1	1.8	1.9	2.0	2.0	2.0	2.3	2.6	2.7
29	2.45	.....	2.0	2.1	1.8	1.9	1.9	1.90	2.6	2.3	2.6	2.7
30	2.45	.....	2.0	2.1	1.8	1.9	1.9	1.90	2.15	2.3	2.5	2.7
31	3.8	.....	2.0	.....	1.8	.....	1.9	1.90	.....	2.3	.....	2.7

GILA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Gila River rises in western and southwestern New Mexico, receiving its waters from mountains having an elevation of from 7,000 to 8,000 feet. At the point where it crosses into Arizona it still has an elevation of 6,000 feet. From this place it flows between mountain ranges, falling rapidly, until at Florence, 180 miles away, it is about 1,500 feet above sea level. At a point about 15 miles above Florence the river emerges upon the plains, through which it winds for about 75 miles before receiving the waters of its principal tributary, the Salt. From the junction of the Salt the Gila continues west and southwest and enters the Colorado at Yuma, Ariz., near the southwestern corner of the Territory.

The principal tributaries are the San Pedro and Santa Cruz rivers from the south, and the San Francisco, Salt, Aqua Fria, and Hassayampa rivers from the north.

San Francisco River rises in the southwestern part of Socorro County, N. Mex., and flows southwestward into Graham County, Ariz., where it unites with the Gila. The basin comprises approximately 1,800 square miles of high, mountainous country.

Salt River, though considered a tributary of the Gila, is in fact larger both in catchment area and in discharge. It receives the drainage from central Arizona, its principal tributary, the Verde, flowing southeasterly and south from the mountains and table-lands south of the Colorado River. The Verde Valley is situated in Yavapai County, Ariz., on the headwaters of the stream, and extends from a canyon above Camp Verde to a point about 10 miles below the fort. About a mile above the junction of the Verde and 30 miles above Phoenix the Salt enters upon the plains of the Gila Valley.

San Pedro River rises in the northern part of the Mexican State of Sonora, flows northward for more than 100 miles, and empties into the Gila a few miles below the town of Dudleyville, 45 miles above Florence, Ariz. Rising in a country of very light snowfall, the river depends for the greater part of its water supply on the frequent showers of the rainy seasons. It flows over a sandy bed between high, steep banks, and during the dry season it shrinks to an insignificant stream of clear water which rises and sinks in the sand with the varying depth of bed rock.

The floods of the upper Gila and its tributaries are usually short and violent, occurring during the months of January and February. The season of low water occurs in June and July.

GILA RIVER NEAR CLIFF, N. MEX.

This station was established September 9, 1904. It is located 9 miles below Cliff post-office and one-half mile below the mouth of Mangos River. It is 40 miles from Silver City, N. Mex. The station is best reached by stage from Silver City to Gila Store, thence by private conveyance. If the river is in flood, the latter part of the journey must be made on horseback.

The channel is straight for 400 feet above and 300 feet below the station. The banks are about 6 feet high, are clean, and are subject to overflow during extreme high water. The bed of the stream is composed of sand and gravel, is free from vegetation, and is shifting. There is but one channel at all stages. At low water the channel, although straight, cuts across the section at a slight angle; during freshets the channel will be at right angles to the measuring section.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire.

The gage is read twice each day by Mrs. Winnie P. Clark. The original gage was a staff fastened to a large cottonwood tree on the east side of the river. This gage was carried out by heavy freshets in the early part of 1905, but observations of gage heights were continued on a temporary gage until February 17, 1905, when the station was temporarily abandoned. On May 22, 1905, the gage was reestablished and the station put in order, and observations of gage heights were again begun. The bench mark is a point marked "U.S.G.S. B.M." with black paint in a blaze on a sycamore tree N. 84° E. 293 feet from the gage; elevation, 8.55 feet above the zero of the gage.

A description of this station, with gage-height data, is contained in Water-Supply Paper No. 133, United States Geological Survey, page 198.

Discharge measurements of Gila River, near Cliff, N. Mex., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 14	F. Asplind	3.15	358	September 20	F. Asplind	2.70	70
June 14[a]	do	3.15	337	September 21	do	2.65	[illegible]
July 7	do	2.10	85	September 22	do	2.75	80
July 8	do	2.05	73	September 23	do	2.75	82
July 9[a]	do	2.05	82	September 24[a]	do	10.20	5,528
July 9[a]	do	2.05	73	September 25	do	3.85	276
July 24	do	2.50	153	September 25	do	3.65	222
July 25	do	2.38	126	September 26	do	3.65	220
July 26	do	2.25	110	September 27	do	3.55	201
July 26[a]	do	4.05	602	September 28	do	3.65	225
July 27	do	2.65	192	October 26	do	3.10	118
July 27	do	2.58	173	October 27	do	3.10	118
July 27	do	2.45	144	October 28	do	3.10	121
July 28	do	2.60	178	October 29	do	3.10	[illegible]
July 28	do	2.40	131	October 30	do	3.10	[illegible]
July 29	do	3.30	338	October 31	do	3.10	121
August 18	do	2.90	184	November 1	do	3.10	120
August 19	do	2.72	106	November 2	do	3.15	134
August 20	do	2.70	95	November 4	do	3.35	[illegible]
August 21	do	2.70	93	November 5	do	3.35	198
August 22	do	2.80	120	November 21	do	3.25	154
August 23	do	2.65	96	November 22	do	3.98	310
August 24	do	2.65	74	November 23[a]	do	5.85	1,091
August 25	do	2.65	74	November 23	do	6.00	1,210
August 26	do	2.80	121	November 24	do	5.15	714
August 27	do	2.75	111	November 25	do	4.60	485
September 19	do	2.70	71	November 26	do	4.45	427

[a] Float measurement.

Daily gage height, in feet, of Gila River, near Cliff, N. Mex., for 1905.

Day.	Jan.	Feb.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	.95	1.05	.....	3.45	2.18	2.9	2.82	3.85	3.1	6.45
2	.9	1.05	.....	3.42	2.18	2.85	4.4	3.7	3.12	5.98
3	.9	1.67	.....	3.48	2.18	2.8	3.8	3.62	3.12	5.55
4	.9	3.97	.....	3.5	2.18	2.9	3.6	3.52	3.22	5.38
5	.9	4.07	.....	3.5	2.18	3.25	3.9	3.42	3.35	[illegible]
6	.9	4.02	.....	3.35	2.12	2.9	3.75	3.4	3.35	5.0
7	.9	3.4	.....	3.3	2.1	2.9	3.52	3.3	3.4	4.88
8	.9	2.9	.....	3.37	2.08	3.55	3.5	3.28	4.17	4.75
9	.93	2.72	.....	3.62	2.05	3.1	3.85	3.22	4.12	4.62
10	.....	2.65	.....	3.55	2.05	3.48	3.65	3.2	4.05	4.6
11	.....	2.6	.....	3.35	2.08	3.5	3.5	3.18	3.85	4.6
12	.....	2.5	.....	3.25	2.1	3.4	3.32	3.15	3.72	4.6
13	.....	2.3	.....	3.18	2.18	3.15	3.22	3.15	3.6	4.55
14	.....	2.15	.....	3.12	2.18	3.07	3.2	3.12	3.65	4.5
15	.....	2.12	.....	3.02	2.18	3.02	3.1	3.1	3.5	4.5
16	.....	2.8	.....	2.97	2.15	2.95	2.95	3.1	3.42	4.45
17	.....	6.45	.....	2.9	2.12	2.9	2.9	3.1	3.4	4.4
18	.....	.....	.....	2.85	2.18	2.95	2.82	3.1	3.35	4.4
19	.....	.....	.....	2.78	2.22	2.75	2.72	3.12	3.3	4.7

Daily gage height, in feet, of Gila River, near Cliff, N. Mex., for 1905—Continued.

Day.	Jan.	Feb.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
20	1.2	.....	.....	2.7	2.28	2.7	2.7	3.1	3.2	4.52
21	1.1	.....	.....	2.65	2.35	2.7	2.68	3.1	3.22	4.48
22	1.1	.....	4.2	2.52	2.3	2.8	2.72	3.1	3.95	4.42
23	1.09	.....	4.05	2.45	2.3	2.67	2.75	3.08	5.8	4.35
24	1.09	.....	4.0	2.38	2.32	2.67	4.88	3.08	5.1	4.22
25	1.1	.....	3.92	2.38	2.32	2.67	3.78	3.1	4.6	4.15
26	1.1	.....	3.85	2.28	3.37	2.85	3.58	3.1	4.42	4.15
27	1.1	.....	3.72	2.28	2.55	2.72	3.55	3.1	11.9	4.15
28	1.1	.....	3.68	2.25	2.6	2.65	3.6	3.1	9.9	4.18
29	1.1	.....	3.62	2.25	3.28	2.65	3.48	3.1	8.25	4.2
30	1.1	.....	3.52	2.22	3.55	2.62	3.9	3.1	7.1	4.2
31	1.1	.....	3.4	.....	2.95	2.7	.....	3.1	.....	4.2

Daily discharge, in second-feet, of Gila River, near Cliff, N. Mex., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	405	93	105	87	268	127	3,190
2	.....	396	93	150	411	235	130	2,387
3	.....	414	93	130	255	219	130	1,570
4	.....	420	93	165	215	219	147	1,247
5	.....	420	93	270	280	183	170	810
6	.....	375	83	165	245	179	170	655
7	.....	360	80	165	199	161	179	532
8	.....	381	77	436	195	158	348	550
9	.....	458	72	250	267	147	335	498
10	.....	436	72	418	225	144	317	490
11	.....	375	77	420	195	141	268	490
12	.....	346	80	385	165	136	239	490
13	.....	326	93	270	147	136	215	470
14	.....	310	93	235	144	130	225	450
15	.....	282	93	215	127	127	195	450
16	.....	268	88	185	105	127	183	430
17	.....	250	83	165	98	127	179	411
18	.....	237	93	185	87	127	170	411
19	.....	218	99	110	73	130	161	530
20	.....	198	110	95	70	127	144	458
21	.....	186	123	95	68	127	147	442
22	648	158	113	130	73	127	292	419
23	598	144	113	85	77	120	985	397
24	582	129	117	85	602	120	715	361
25	556	129	117	85	251	127	490	342
26	532	110	381	150	211	127	419	342
27	490	110	164	100	205	127	13,640	342
28	478	104	178	80	215	127	9,835	349
29	458	104	354	80	192	127	6,700	355
30	426	99	436	65	280	127	4,515	355
31	390	.....	263	95	.....	127	.....	355

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of Gila River, near Cliff, N. Mex., for 1905.

[Drainage area, 2,450 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May 22-31	648	390	516	10,230	0.211	0.07[illegible]
June	458	99	272	16,180	.111	.124
July	436	72	133	8,178	.054	.062
August	436	65	182	11,190	.074	.085
September	602	68	192	11,420	.078	.087
October	268	120	149	9,162	.061	.07[illegible]
November	13,640	127	1,392	82,830	.568	.634
December	3,190	342	665	40,890	.271	.312
The period				190,100		

GILA RIVER AT SAN CARLOS, ARIZ.

This station was established July 11, 1899, in connection with the investigation of the water supply of the Gila Valley.[a] It is located one-half mile south of the Indian agency at San Carlos and below the mouth of San Carlos Creek.

The channel is straight for some distance above and below the station, and the water is comparatively swift. The right bank is high, but the left is low and liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from a cable and car a short distance above the gage rod. The gage at this station is read by R. H. Ross. The original gage was an inclined rod securely fastened to posts driven into the left bank. During the heavy floods of January, February, and March, 1905, the cable and gage were washed away, and there are breaks in the gage records for those months. In April and May, 1905, the station was visited by Mr. Gerard H. Matthes, who constructed an approximate gage record covering the period between April 1 and May 14, based on the data available at that time. On May 14 a chain gage was established on the right bank of the river about 500 feet below the new cable. In August, 1905, new cables were placed in position and the station was rebuilt. Owing to the fact that the channel left the chain gage during low water, an inclined gage was placed on the right bank of the stream about 60 feet above the cable for use at low stages. The zero of this gage coincides in elevation with the zero of the chain gage. The bench marks are as follows: (1) Nail in cottonwood tree on edge of bank 50 yards upstream from gage; elevation, 23.38 feet. (2) Nail in cottonwood tree near ditch back of gage; elevation, 20.58 feet. (3) Three nails driven at the same level in three forks of old cottonwood tree on irrigating ditch one-third mile north of gage; elevation, 23.85 feet. Elevations are above the zero of the gage. This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 38, pp 313-314; 50, p 385; 66, p 98; 85, pp 32-33; 100, p 48; 133, p 199.
Discharge: WS 38, p 314; 50, p 386; 66, p 99; 85, p 33; 100, p 50; 133, pp 200-202.
Discharge, mean daily: WS 133, p 203.
Discharge, monthly: Ann 21, iv, p 332; 22, iv, p 397; WS 75, p 179; 85, p 35; 100, p 51; 133, p 204.
Gage heights: WS 38, p 314; 50, p 386; 66, p 99; 85, p 34; 100, p 49; 133, p 202.
Hydrographs: Ann 21, iv, p 332; 22, iv, p 398; WS 75, p 180.
Rating tables: WS 39, p 452; 52, p 520; 85, pp 34-35.

[a] The results of this investigation are set forth in Water-Supply and Irrigation Paper No. 33, entitle "Storage of Water on Gila River, Arizona," by J. B. Lippincott.

Discharge measurements of Gila River at San Calos, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 6	R. H. Ross	1.45	127	October 15	F. Rabinnovitz	11.25	117
June 14	Matthes & Rabinnovitz.	11.12	422	October 17	do	11.20	65
June 25	F. Rabinnovitz	10.80	28	October 26	do	11.05	42
June 30	do	10.50	58	October 28	do	11.00	28
July 14	do	10.82	178	October 30	do	11.05	57
July 31	do	11.44	243	November 2	do	11.15	58
August 5	do	11.15	213	November 4	do	11.10	76
August 11	do	11.57	957	November 6	do	11.45	292
September 17	do	11.50	168	November 10	do	12.45	1,438
September 24	do	11.35	89	November 13	do	11.90	766
September 30	do	12.10	760	November 15	do	11.75	461
October 9	do	11.40	109	November 17	do	11.80	492
October 12	do	11.30	78	November 20	do	11.70	381
October 21	do	11.15	36	November 22	do	12.00	951
October 24	do	11.10	46	November 24	do	13.20	3,237

Daily gage height, in feet, of Gila River, at San Carlos, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.5	1.7	5.6	.....	13.35	11.05	10.5	11.38	11.38	12.05	11.15
2	1.5	1.7	5.3	12.8	13.3	11.05	10.5	11.3	11.22	11.88	11.15
3	1.5	1.7	5.5	13.65	13.3	11.01	10.5	11.16	11.3	11.9	11.12
4	1.5	5.55	5.4	14.4	13.2	11.99	10.5	11.2	11.8	11.82	11.1
5	1.45	4.9	5.35	14.35	13.0	11.01	10.5	11.15	11.8	11.72	11.18
6	1.45	4.9	4.9	13.45	12.85	11.02	10.5	11.12	12.6	11.62	11.48
7	1.45	4.4	4.5	12.8	12.6	11.99	10.5	11.1	12.35	11.52	11.42
8	1.45	3.8	4.8	13.0	12.35	11.07	10.5	11.22	12.17	11.48	11.7
9	1.45	3.42	6.7	12.7	12.3	11.11	10.5	11.78	11.8	11.4	12.78
10	7.0	3.2	5.55	12.75	12.2	11.36	10.5	11.52	11.92	11.35	12.48
11	.....	3.15	5.1	12.9	12.2	11.26	10.55	11.52	11.95	11.35	12.2
12	.....	3.05	4.6	14.7	12.2	11.25	10.38	11.42	11.8	11.32	12.05
13	.....	2.95	4.1	14.9	12.05	11.22	10.62	11.34	11.7	11.3	11.92
14	.....	2.78	5.1	14.65	11.95	11.14	10.88	11.38	11.65	11.28	11.8
15	.....	2.7	5.1	14.15	11.9	11.14	10.7	11.27	11.6	11.22	11.78
16	.....	2.85	4.5	14.1	11.86	11.08	10.68	11.1	11.5	11.2	11.72
17	.....	5.05	8.0	14.3	11.82	11.06	10.6	11.07	11.5	11.2	11.75
18	.....	7.9	.....	14.5	11.81	11.07	10.58	11.02	11.42	11.15	11.7
19	.....	9.0	.....	14.0	11.8	11.05	10.5	11.04	11.35	11.15	11.65
20	.....	4.45	.....	13.9	11.77	11.01	10.48	11.1	11.32	11.15	11.68
21	.....	3.7	.....	13.75	11.69	11.26	10.45	11.04	11.28	11.15	11.65
22	.....	3.35	.....	13.7	11.65	10.72	10.28	11.55	11.25	11.15	12.0
23	.....	3.2	.....	13.7	11.50	10.92	10.18	11.17	11.25	11.12	13.02
24	.....	3.65	.....	14.3	11.57	10.9	10.13	11.56	11.75	11.1	13.2
25	.....	4.95	.....	14.5	11.48	10.84	10.13	[a]11.45	12.08	11.1	13.1
26	.....	3.75	.....	14.85	11.43	10.79	10.1	11.45	12.62	11.05	12.8
27	.....	3.4	.....	14.6	11.35	10.72	10.11	11.35	12.35	11.0	14.88
28	.....	3.3	.....	14.0	11.28	10.66	10.87	11.22	12.15	11.0	.....
29	.....	.....	.....	13.7	11.21	10.62	11.5	11.65	12.0	11.0	.....
30	.....	.....	.....	13.45	11.16	10.55	11.58	11.1	12.08	11.02	.....
31	.....	.....	.....	.....	11.13	.....	11.4	11.1	.....	11.08	.....

[a] Gage washed out. River changed its course. New gage set same level.

GILA RIVER AT DOME (GILA CITY), ARIZ.

This station was established October 15, 1903. It is located 20 miles above the junction of the Gila with the Colorado. The point of gaging first established was one-fourth mile north of the depot at Dome. The river now flows in a channel fully 1 mile north of the original channel.

The Gila carries an enormous amount of mud and sand. At times the waves of sand traveling along the bed of the stream are so large, the current is so swift, and the stream to shallow, that the water is broken into a uniform succession of waves 2 feet high and over. During 1905 there have been ten floods reaching a maximum mean discharge for twenty-four hours, as follows: Two floods of 95,000 second-feet or over; 1 flood of 80,000 second-feet or over; 2 floods of 40,000 second-feet or over; 5 floods of 13,000 second-feet or over. At every flood the channel shifts. The valley at its narrowest is half a mile wide and the waters may occupy any part or all of it. There is no place on the lower part of the Gila where a permanent cable can be erected at a reasonable expense.

Up to about 8,000 second-feet discharge measurements are made by means of a boat and cable above that by means of floats. When the Colorado above the Gila is known to be constant the crest of the flood is measured after it joins the Colorado at Yuma, and an allowance of 5 per cent is made for flattening of the crest between Dome and Yuma.

The gage observer is B. Rinehart. Fourteen gages have been put in by the hydrographer since the establishment of the station, not including temporary rods placed by the observer.

The permanent bench mark is a standard United States Geological Survey iron post at the southwest corner of depot under platform, marked "189 Y"; elevation, 189.60 feet above sea level and 31.97 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 133, p 204.
Discharge: 133, p 205.
Discharge, monthly: 133, p 206.
Gage heights: 100, p 27; 133, p 205.

Discharge measurements of Gila River at Dome (Gila City), Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 14	W. D. Smith	8.25	3,323	April 14	W. D. Smith	12.60	[b]88,000
January 15	do	9.20	4,287	May 30	do	7.00	[c]2,289
January 15	do	9.90	4,941	June 13	do	5.90	749
January 16	do	12.80	17,300	September 19	do	3.70	33
January 17	do	14.60	[a]23,000	October 5	do	6.00	735
January 24	do	6.10	2,305	October 9	do	4.70	374
February 8	do	16.95	[a]80,000	November 28	do	7.10	2,467
March 20	do	13.10	[a]95,000	November 29	do	14.70	[d]95,000
April 4	do	9.00	[b]6,552				

[a] Estimated from gaging at Yuma, Ariz.
[b] Float measurement.
[c] Measurement made 4 miles above Yuma, Ariz.
[d] Estimated from the discharge of the Colorado River at Yuma and from gage observations at Dome, Picacho, and Laguna.

Daily gage height, in feet, of Gila River at Dome (Gila City), Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.	Dec.
1	.....	3.1	8.05	8.5	9.1	6.7	.....	.....	.....	.....	.....
2	.....	2.75	10.65	8.5	8.8	6.5	4.4	.....	.....	.....	.....
3	.....	2.45	11.55	8.3	8.9	6.0	.....	.....	6.6	.....	.....
4	.....	2.3	9.5	8.6	8.7	.....	4.2	.....	6.4	.....	.....
5	.....	3.55	8.0	8.9	8.3	.....	.....	.....	6.0	.....	8.2
6	.....	7.0	7.3	9.6	8.4	.....	4.0	.....	5.6	.....	8.0
7	.....	14.0	6.15	9.8	8.3	.....	.....	.....	5.0	.....	7.7
8	.....	16.95	5.4	9.0	8.0	.....	3.9	.....	.....	.....	7.6
9	.....	15.45	5.2	8.8	8.0	.....	.....	.....	4.7	.....	7.5
10	3.0	13.1	5.0	8.9	8.0	.....	3.8	.....	.....	.....	7.7
11	7.0	10.75	8.0	9.0	7.7	.....	.....	.....	4.3	.....	7.5
12	7.5	7.25	9.2	8.9	8.2	.....	3.7	.....	.....	.....	7.4
13	7.8	4.25	7.6	10.7	8.0	5.9	.....	4.8	4.0	.....	.....
14	7.95	6.75	7.5	12.6	7.8	5.9	3.7	4.6	.....	4.5	7.4
15	9.45	5.0	9.25	11.55	7.9	.....	.....	4.4	3.7	5.0	.....
16	13.7	4.0	11.8	10.8	8.0	6.0	3.6	.....	.....	5.0	7.5
17	14.6	4.55	10.5	10.0	8.0	.....	.....	3.8	3.6	.....	.....
18	12.0	4.8	11.15	9.35	7.9	5.9	3.6	.....	.....	4.5	7.6
19	10.1	10.95	12.55	8.85	7.6	.....	.....	3.7	3.5	.....	.....
20	8.7	11.95	13.1	8.35	7.8	5.7	3.5	.....	.....	4.2	7.6
21	8.05	12.05	11.0	8.05	7.6	.....	.....	3.6	.....	.....	.....
22	7.45	11.85	10.5	8.4	7.7	5.4	3.5	3.5	.....	4.1	7.6
23	6.65	5.7	10.3	8.85	7.8	.....	.....	3.5	.....	.....	7.7
24	6.1	5.0	10.1	8.75	7.6	5.1	.....	.....	.....	4.1	7.7
25	5.75	6.0	9.9	9.05	7.5	.....	.....	.....	.....	.....	.....
26	5.45	9.05	9.7	9.65	7.5	4.9	.....	.....	.....	4.1	7.8
27	5.25	8.05	9.5	9.55	7.5	.....	.....	.....	.....	.....	.....
28	4.95	8.1	9.3	9.7	7.4	4.7	.....	.....	.....	6.1	7.5
29	4.6	.....	9.1	9.65	7.2	.....	.....	.....	.....	14.7	.....
30	4.1	.....	8.9	9.4	7.0	4.5	.....	.....	.....	12.6	7.4
31	3.6	.....	8.7	.....	6.9	.....	.....	.....	.....	.....	7.4

NOTE.—No gage record June 4 to 12. No flow during August.

Daily discharge, in second-feet, of Gila River at Dome (Gila City), Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.	Dec.
1	.....	80	5,150	6,800	9,500	1,850	280	.....	.....	.....	30,700
2	.....	.....	21,500	6,800	8,100	1,550	270	.....	.....	.....	24,400
3	.....	.....	34,000	6,000	8,500	900	240	.....	940	.....	18,200
4	.....	.....	11,800	7,300	7,700	880	210	.....	870	.....	11,900
5	.....	280	5,000	8,500	6,000	860	180	.....	750	.....	5,700
6	.....	2,220	3,050	12,400	6,400	840	150	.....	630	.....	5,000
7	.....	20,800	1,050	13,800	6,000	830	140	.....	450	.....	4,100
8	.....	82,000	450	9,000	5,000	810	120	.....	400	.....	3,800
9	.....	35,800	370	8,100	5,000	790	100	.....	360	.....	3,600
10	40	14,900	300	8,500	5,000	770	90	.....	300	.....	4,100
11	2,220	6,900	5,000	9,000	4,100	750	80	.....	240	.....	3,600
12	2,600	2,920	10,000	8,500	5,600	730	60	.....	200	.....	3,300
13	2,840	60	3,800	22,000	5,000	720	60	390	150	.....	3,300
14	2,960	1,920	3,500	64,000	4,400	720	60	330	100	390	3,300
15	4,680	300	10,300	34,000	4,700	740	40	270	60	450	3,400
16	18,600	.....	39,000	23,000	5,000	750	30	180	40	450	3,600

Daily discharge, in second-feet, of Gila River at Dome (Gila City), Ariz., for 1905—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Sept.	Oct.	Nov.	Dec.
17	26,000	140	20,000	15,300	5,000	740	30	90	30	380	3,700
18	10,200	230	27,800	10,900	4,700	720	30	80	20	300	3,400
19	5,650	24,800	62,000	8,300	3,800	690	20	60	.....	260	3,400
20	3,690	42,800	95,000	6,200	4,400	660	.....	40	.....	210	3,400
21	3,060	45,200	25,500	5,150	3,800	620	.....	30	.....	200	3,400
22	2,560	40,200	20,000	6,400	4,100	570	.....	20	.....	180	3,400
23	1,990	630	18,000	8,300	4,400	520	.....	.....	.....	180	4,100
24	1,660	300	16,100	7,900	3,800	480	.....	.....	.....	180	4,100
25	1,460	900	14,500	9,250	3,500	450	.....	.....	.....	180	4,200
26	1,290	9,250	13,100	12,750	3,500	420	.....	.....	.....	180	4,400
27	1,180	5,150	11,800	12,100	3,500	390	.....	.....	.....	480	4,000
28	1,020	5,300	10,600	13,100	3,300	360	.....	.....	.....	780	3,600
29	830	.....	9,500	12,750	2,800	330	.....	.....	.....	95,000	3,400
30	560	.....	8,500	11,200	2,350	300	.....	.....	.....	36,900	3,300
31	310	.....	7,700	.....	2,150	.....	.....	.....	.....	.....	3,300

NOTE.—Daily discharge obtained from several rating tables, each covering a short period of time. Discharge estimated for missing gage heights. No flow during August.

Estimated monthly discharge of Gila River at Dome (Gila City), Ariz., for 1905.

[Drainage area, 71,050 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	26,000	0	3,077	189,200	0.043	0.050
February	82,000	0	12,250	680,300	.172	.179
March	95,000	300	16,590	1,020,000	.233	.269
April	64,000	5,150	12,910	768,200	.182	.203
May	9,500	2,150	4,874	299,700	.069	.080
June	1,850	300	725	43,140	.010	.011
July	280	0	70.6	4,341	.00099	.0011
August	0	0	0	0	.0	.0
September	390	0	49.7	2,957	.00070	.0007[illegible]
October	940	0	179	11,010	.0025	.0029
November	95,000	0	4,557	271,200	.064	.071
December	30,700	3,300	6,100	375,100	.086	.099
The year	95,000	0	5,115	3,665,000	.072	.967

SAN FRANCISCO RIVER AT ALMA, N. MEX.

This station was established October 18, 1904. It is located about one-half mile south of Alma, N. Mex., and 85 miles northwest of Silver City. It is best reached by stage from Silver City, which makes the trip daily except Sundays.

The channel is straight for about 500 feet above and below the station. The banks are about 4 feet high, are clean, and are subject to overflow during extreme high water. The bed of the stream is composed of gravel, is free from vegetation, and is firm and regular. The current is swift.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the zero of the tagged wire. The cable was carried away by

a heavy flood on March 16, 1905, but was recovered and restored at a point about 600 feet higher upstream on March 24. Measurements prior to March 16 were taken at the lower section; since then the upper section has been used.

The gage, which is read twice each day by Mrs. Ella D. Hollimon, consists of a staff fastened to the east or left bank of the stream. The gage was washed out by the flood of March 16, 1905, but was immediately replaced in its old position. The bench mark is a 20-penny nail driven into a blaze in a cottonwood tree 118.5 feet N. 73° E. from the gage; it is marked "U. S. G. S. B. M."; elevation above the zero of the gage, 9.06 feet.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 206–208.

Discharge measurements of San Francisco River at Alma, N. Mex., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
February 8	Frank Asplind	4.50	[a] 362	May 30	Frank Asplind	2.25	63
February 10	do	3.70	[a] 172	May 30	do	2.25	[a] 60
February 14	do	3.90	[a] 209	May 31	do	2.2	54
February 27	do	4.30	[a] 294	June 3	do	2.15	43
March 4	do	5.20	[a] 1,463	June 4	do	2.15	[a] 45
March 11	do	3.80	[a] 767	June 6	do	2.10	35
March 13	do	3.20	[a] 385	June 7	do	2.10	[a] 32
March 14	do	4.4	[a] 1,098	June 16	do	2.65	24
March 15	do	4.6	[a] 1,207	June 17	do	2.05	[a] 22
March 16	do	4.0	[a] 925	June 19	do	2.00	22
March 25	do	4.1	[a] 1,068	June 20	do	2.00	[a] 21
March 27	do	4.2	[a] 1,065	June 21	do	1.95	16.8
April 3	do	5.70	[a] 2,835	June 23	do	1.90	12.4
April 4	do	4.30	[a] 1,634	June 24	do	1.85	9.1
April 6	do	5.40	[a] 2,517	June 26	do	1.80	5.8
April 7	do	5.00	[a] 2,115	June 29	do	1.75	4.0
April 11	do	4.20	[a] 1,336	July 15	do	1.95	15.5
April 12	do	4.70	[a] 1,719	July 15	do	2.00	21
April 14	do	4.50	[a] 1,546	July 18	do	1.90	12.5
April 18	do	3.90	933	July 20	do	2.15	40
April 19	do	3.80	806	July 21	do	2.20	52
April 22	do	3.55	502	August 1	do	2.15	33
April 24	do	4.50	1,478	August 2	do	2.15	29
April 26	do	4.05	1,128	August 3	do	2.10	23
April 27	do	3.90	970	August 4	do	2.18	33
April 29	do	3.75	828	August 5	do	2.20	40
May 2	do	3.55	629	August 8	do	2.50	104
May 4	do	3.30	479	August 9	do	2.20	39
May 6	do	3.00	[a] 359	August 10	do	2.20	40
May 9	do	3.00	333	August 11	do	2.22	46
May 12	do	2.90	289	August 11	do	2.45	79
May 12	do	2.90	[a] 251	August 12	do	2.30	54
May 14	do	2.85	261	August 14	do	2.15	27
May 14	do	2.85	[a] 238	August 15	do	2.10	19.2
May 16	do	2.80	234	August 16	do	2.05	16.7
May 16	do	2.80	[a] 211	August 30	do	2.15	10.9
May 25	do	2.4	95	August 31	do	2.30	31
May 26	do	2.4	[a] 95	September 2	do	2.20	16.1
May 27	do	2.35	83	September 3	do	3.55	[a] 741
May 28	do	2.30	72	September 4	do	2.40	65
May 28	do	2.30	[a] 70	September 4	do	4.30	[a] 1,218

[a] Float measurement.

Discharge measurements of San Francisco River at Alma, N. Mex., in 1905—Continued.

Date	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
September 5	Frank Asplind	2.82	248	October 24	Frank Asplind	2.40	68
September 6	do	3.25	455	November 7	do	2.40	59
September 7	do	2.32	80	November 8	do	3.20	220
September 8	do	2.25	58	November 9	do	2.72	99
September 9	do	2.30	71	November 10	do	2.52	68
September 11	do	2.20	49	November 11	do	2.40	51
September 12	do	2.15	39	November 13	do	2.45	61
September 13	do	2.10	30	November 15	do	2.40	54
September 14	do	2.10	28	November 17	do	2.40	55
September 16	do	2.10	28	November 18	do	2.40	55
October 2	do	2.30	[a] 58	December 6	do	2.25	167
October 3	do	2.25	[a] 46	December 7	do	1.95	107
October 4	do	2.20	37	December 9	do	1.75	72
October 5	do	2.20	37	December 11	do	1.75	68
October 6	do	2.20	36	December 12	do	1.70	60
October 7	do	2.20	36	December 13	do	1.70	59
October 9	do	2.20	37	December 14	do	1.65	50
October 10	do	2.20	36	December 15	do	1.60	42
October 11	do	2.20	34	December 16	do	1.62	46
October 12	do	2.20	36	December 18	do	1.60	42
October 13	do	2.20	36	December 19	do	1.60	43
October 14	do	2.20	35	December 20	do	1.60	42
October 16	do	2.20	35	December 22	do	1.60	43
October 18	do	2.20	34	December 23	do	1.50	34
October 19	do	2.20	36	December 26	do	1.45	30
October 20	do	2.20	35	December 28	do	1.50	33
October 21	do	2.20	33	December 29	do	1.45	28
October 23	do	2.40	68	December 30	do	1.45	27

[a] Float measurement.

Daily gage height, in feet, of San Francisco River at Alma, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	2.2	5.85	3.6	3.52	2.2	1.8	2.35	2.3	2.5	2.3	.....
2	1.2	2.8	5.5	4.15	3.5	2.18	1.8	2.1	2.2	2.48	2.5	.....
3	1.2	2.45	5.55	5.0	3.4	2.1	1.8	2.05	2.2	2.35	2.5	2.42
4	1.2	5.0	5.55	4.4	3.4	2.1	1.78	2.05	2.5	2.3	2.6	2.42
5	1.2	5.0	5.6	4.9	3.3	2.0	1.75	2.1	2.5	2.3	2.9	2.32
6	1.2	5.15	4.7	4.85	3.15	2.0	1.78	2.15	2.4	2.2	3.8	2.25
7	1.2	4.8	5.0	4.75	3.1	2.0	1.8	2.05	2.3	2.2	3.6	2.1
8	1.2	4.5	5.42	4.6	3.1	2.2	1.8	3.25	2.3	2.2	3.8	1.85
9	1.75	4.25	4.35	4.25	3.1	2.18	1.8	2.35	2.3	2.2	3.0	1.8
10	5.85	3.7	3.75	4.25	3.0	2.1	1.8	2.2	2.25	2.15	2.52	1.72
11	3.4	3.2	3.6	4.2	3.0	2.1	1.8	2.5	2.22	2.15	2.5	1.7
12	2.65	3.5	3.4	4.45	2.95	2.1	1.8	2.35	2.22	2.2	2.42	1.68
13	2.4	3.7	3.2	4.95	2.9	2.0	1.8	2.3	2.15	2.2	2.4	1.68
14	2.35	3.9	4.35	4.42	2.82	2.0	1.8	2.2	2.12	2.2	2.4	1.68
15	2.3	3.65	4.3	4.2	2.8	2.0	1.9	2.2	2.1	2.2	2.4	1.62
16	2.3	3.85	4.0	3.95	2.8	2.0	1.9	2.18	1.98	2.2	2.4	1.62
17	2.3	6.3	5.9	3.85	2.77	2.0	2.0	2.12	2.0	2.2	2.4	1.58
18	2.3	6.4	5.1	3.85	2.75	1.92	1.9	2.1	2.0	2.2	2.4	1.52

Daily gage height, in feet, of San Francisco River at Alma, N. Mex., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
19	2.3	3.75	4.7	3.8	2.75	1.95	1.9	2.1	2.0	2.2	2.35	1.52
20	2.22	3.8	5.2	3.7	2.7	1.9	2.1	2.0	2.0	2.2	2.35	1.52
21	2.22	3.0	4.6	3.6	2.7	1.9	2.1	2.85	2.1	2.2	2.52	1.62
22	2.21	2.9	4.5	3.52	2.7	1.9	2.1	2.8	2.2	2.2	3.85	1.65
23	2.21	4.35	4.5	4.55	2.55	1.9	2.15	2.35	3.2	2.2	3.62	1.62
24	2.2	3.22	4.3	4.7	2.5	1.9	2.0	2.1	4.65	2.4	3.3	1.62
25	2.15	3.95	4.1	4.4	2.45	1.88	2.0	2.05	3.5	2.38	2.7	1.52
26	2.1	3.75	4.1	4.0	2.42	1.82	2.0	2.1	3.2	2.3	2.62	1.42
27	2.1	4.4	4.0	3.9	2.37	1.8	2.0	2.1	3.2	2.3	.....	1.42
28	2.1	6.05	3.85	4.0	2.3	1.8	2.0	2.15	3.12	2.3	.....	1.42
29	2.2	.....	3.75	3.7	2.27	1.8	2.75	2.3	2.8	2.3	.....	1.38
30	2.35	.....	3.5	3.5	2.25	1.8	2.25	3.05	2.6	2.3	.....	1.38
31	2.5	.....	3.55	.....	2.22	.....	2.35	2.85	.....	2.3	.....	1.38

Daily discharge, in second-feet, of San Francisco River at Alma, N. Mex., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	190	3,410	681	618	52	6	72	27	115	45	.....
2	10	570	2,360	1,155	602	48	6	24	16	100	85	.....
3	10	287	2,510	2,048	548	32	6	18	75	65	85	215
4	10	910	2,510	1,380	548	32	5	21	90	55	115	215
5	10	910	2,660	1,932	494	20	4	26	120	55	210	185
6	10	1,310	460	1,874	413	20	5	32	85	36	755	162
7	10	560	910	1,758	386	20	6	20	74	36	575	120
8	10	370	2,120	1,590	386	52	6	425	74	36	550	74
9	80	295	325	1,245	386	48	6	72	74	36	190	67
10	3,162	170	180	1,245	332	32	6	40	63	25	75	56
11	1,080	110	155	1,200	332	32	6	110	36	25	70	53
12	357	140	130	1,430	306	32	6	63	56	36	60	51
13	260	170	110	1,990	280	20	6	50	42	36	55	51
14	240	210	325	1,400	240	20	6	33	36	36	55	51
15	220	163	310	1,200	230	20	12	30	32	36	55	44
16	220	200	230	975	230	20	12	30	18	36	55	44
17	220	4,760	3,092	885	215	20	20	23	17	36	55	40
18	220	5,060	2,164	885	205	14	12	19	17	36	55	35
19	220	180	1,700	840	205	16	12	16	17	36	45	35
20	196	190	2,280	760	180	12	32	9	17	36	45	35
21	196	90	1,590	681	180	12	32	75	25	36	85	44
22	193	80	1,480	618	180	12	32	55	40	36	750	48
23	193	325	1,480	1,535	135	12	42	42	415	36	585	44
24	190	112	1,290	1,700	120	12	20	12	1,575	68	405	44
25	175	220	1,110	1,380	107	11	20	8	565	60	125	35
26	160	180	1,110	1,020	99	8	20	11	405	45	110	27
27	160	340	1,020	930	88	6	20	9	405	45	.....	27
28	160	4,010	885	1,020	74	6	20	11	365	45	.....	27
29	190	.....	800	760	88	6	205	23	195	45	.....	25
30	240	.....	602	602	64	6	63	220	125	45	.....	25
31	315	.....	642	.....	58	.....	85	160	.....	45	.....	25

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of San Francisco River at Alma, N. Mex., for 1905.

[Drainage area, 1,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	3,162	10	282	17,340	0.157	0.181
February	5,060	80	790	43,870	.439	.457
March	3,410	110	1,289	79,260	.716	.826
April	2,048	602	1,224	72,830	.680	.759
May	618	58	269	16,540	.149	.172
June	52	6	21.8	1,297	.012	.013
July	205	4	23.8	1,463	.013	.015
August	425	8	56.7	3,486	.032	.037
September	1,575	16	170	10,120	.094	.105
October	115	25	45.6	2,804	.025	.029
November 1-26	755	45	204	10,520	.113	.109
December 3-31	215	25	65.7	3,779	.036	.039
The period				263,300		

SAN PEDRO RIVER AT CHARLESTON, ARIZ.

This station was established January 22, 1904. It is located about one-half mile west of Charleston station on the El Paso and Southwestern Railroad and 6 miles south of Fairbank, Ariz.

The channel is straight for about 800 feet above and 500 feet below the station. Both banks are nearly vertical for 20 feet, are clean, and are not subject to overflow. The bed of the stream is composed of sand and is shifting. At high water there is but one channel, but at low water the channel is divided by sand bars. The current is swift.

Discharge measurements are made at high water by a cable and car 10 feet below the gage. The initial point for soundings is 21 feet from the cable support on the east bank. Low-water measurements are made by wading.

The gage is read twice each day by H. R. Fry. The original gage was read until March 28, 1904, when a second gage was established 200 feet upstream from the first. The second gage, which was read from March 29 to July 30, 1904, is in two sections: The upper section is attached vertically to a cottonwood tree on the left bank; the upper end of the lower section, which is inclined, is fastened to the same tree and the lower end is set in the bed of the stream. In July and August, 1904, floods changed the channel to such an extent that a third gage became necessary. This was established August 15, 1904, on the east bank, directly opposite the old or second gage, and consists of a vertical rod fastened to a dead-man in the bank at the same datum as the old gage. Readings have since been made from the third gage. The bench marks are as follows: (1) A United States Geological Survey standard iron bench-mark post near a post on the east side of the El Paso and Southwestern Railroad station at Charleston; elevation, 57.265 feet above the zero of the gage and 3,957.265 feet above mean sea level. (2) A spike in the west side of the root of a tree on the west bank of the river, 100 feet above the gage; elevation, 35.860 feet above the zero of the gage and 3,935.860 feet above mean sea level.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 208-211.

Discharge measurements of San Pedro River at Charleston, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft*
January 4	H. R. Fry	26.05	24	June 28	H. R. Fry	26.30	17
January 11	do	26.90	124	July 5	do	26.15	12
January 18	do	26.80	35	July 12	do	27.30	122
January 25	do	26.70	31	July 19	do	26.25	14
February 1	do	26.40	23	July 29	do	26.50	61
February 9	do	27.25	120	August 7	do	.....	38
February 15	do	26.60	36	August 12	do	26.00	46
February 21	do	27.35	147	August 17	do	26.05	82
March 1	do	27.10	111	August 26	do	26.80	133
March 22	do	26.85	81	September 7	do	26.30	80
March 30	do	26.80	99	September 15	do	25.60	37
April 5	do	26.30	71	September 21	do	25.70	38
April 12	do	26.20	50	September 28	do	26.10	62
April 19	do	26.30	79	October 4	W. Rayling	25.60	28
April 26	do	26.00	37	October 11	do	25.50	34
May 3	do	26.15	51	October 18	do	25.60	31
May 10	do	25.95	31	October 25	do	25.50	27
May 17	do	25.85	25	November 1	do	25.50	23
May 24	do	25.85	22	November 8	do	25.40	24
May 24	do	25.85	20	November 15	do	25.70	42
May 31	do	25.82	18	November 22	do	25.80	54
June 7	do	25.80	18	December 6	do	.....	98
June 14	do	26.65	52	December 13	do	.....	102
June 21	do	26.35	20	December 20	do	25.50	61
June 28	do	26.30	20	December 27	do	25.40	54

NOTE.—Gage washed away by flood on November 28.

Daily gage height, in feet, of San Pedro River at Charleston, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	26.15	26.4	27.1	26.65	26.35	25.82	26.25	.....	25.65	25.8	25.5	.....
2	26.1	26.4	28.02	26.57	26.25	25.82	26.25	.....	26.85	25.8	25.5	.....
3	26.1	26.4	27.52	26.45	26.15	25.82	26.25	.....	27.6	25.7	25.5	.....
4	26.05	26.5	27.7	26.3	26.15	25.82	26.22	.....	27.75	25.6	25.5	.....
5	26.05	27.1	27.8	26.27	26.05	25.78	26.15	.....	28.25	25.5	25.5	.....
6	26.05	26.62	27.45	26.22	26.05	25.8	26.18	.....	26.5	25.5	25.5	.....
7	26.1	27.9	27.75	26.17	26.05	25.8	26.18	.....	26.35	25.35	25.35	.....
8	26.1	27.6	28.85	26.1	25.92	25.85	26.18	.....	26.45	25.5	27.2	.....
9	26.1	27.2	27.85	26.1	25.92	26.00	26.22	27.5	26.0	25.5	27.55	.....
10	26.65	26.87	28.5	26.1	25.95	27.65	26.22	26.9	25.95	25.5	26.75	.....
11	26.9	26.85	27.35	26.1	25.9	27.15	26.48	26.8	25.55	25.5	26.7	.....
12	26.9	26.8	27.87	26.2	25.9	26.85	27.28	26.0	25.55	27.0	25.9	.....
13	26.85	26.7	27.1	26.47	25.87	26.68	27.32	26.35	25.55	27.0	25.8	.....
14	26.9	26.65	27.06	27.3	25.85	26.6	26.62	27.0	25.55	26.45	25.7	.....
15	26.9	26.6	27.1	26.9	25.85	26.6	26.45	26.05	25.9	26.2	25.7	.....
16	26.95	26.6	26.9	26.5	25.82	26.52	26.35	26.85	26.3	26.0	25.7	.....
17	26.85	26.65	30.85	26.3	25.82	26.5	26.32	27.92	26.4	25.8	25.7	25.5
18	26.85	26.85	28.25	26.3	25.82	26.42	26.25	26.1	26.35	25.6	25.6	25.5
19	26.8	27.65	27.6	26.27	25.82	26.42	26.25	27.75	25.9	25.6	25.6	25.5
20	26.8	27.8	27.23	26.2	25.8	26.35	26.2	28.15	25.7	25.6	25.6	25.5
21	26.8	27.27	26.95	26.15	25.83	26.35	26.22	29.1	26.2	25.6	25.6	25.6

Daily gage height, in feet, of San Pedro River at Charleston, Ariz., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
22	26.8	27.12	26.85	26.2	25.83	26.3	26.22	27.85	26.25	25.5	26.0	25.5
23	26.8	26.9	26.9	26.17	25.83	26.3	26.18	27.15	25.8	25.5	25.8	25.4
24	26.75	26.82	26.9	26.15	25.83	26.28	26.18	26.45	25.9	25.5	26.1	25.4
25	26.65	26.6	26.85	26.0	25.83	26.28	28.1	27.15	27.8	25.5	25.8	25.4
26	26.55	26.75	26.6	26.97	25.83	26.25	28.45	26.8	27.25	25.5	25.8	25.4
27	26.5	26.6	26.42	25.95	25.83	26.25	28.32	26.6	26.4	25.5	29.15	25.4
28	26.45	26.65	26.32	25.95	25.82	26.3	26.95	26.1	26.15	25.5	29.3	25.4
29	26.45	.....	26.3	26.2	25.82	26.25	26.5	25.85	26.1	25.5	.....	25.4
30	26.45	.....	26.82	26.41	25.82	26.28	26.5	25.75	25.9	25.5	.....	25.4
31	26.4	.....	26.75	.....	25.82	.....	26.3	25.85	.....	25.5	.....	25.4

NOTE.—Gage washed out by flood November 28.

Daily discharge, in second-feet, of San Pedro River at Charleston, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	36	23	110	91	64	18	15	.....	44	41	23	.....
2	30	23	247	86	58	18	15	.....	49	41	23	.....
3	30	23	172	79	51	18	15	.....	177	34	23	.....
4	24	25	164	71	51	18	14	.....	186	28	23	.....
5	24	47	114	70	42	16	12	.....	219	24	23	.....
6	24	27	162	56	42	17	13	.....	95	25	23	.....
7	30	235	207	48	42	17	13	.....	83	17	21	.....
8	30	180	370	44	43	18	13	.....	90	29	149	.....
9	30	108	222	44	31	25	14	135	61	30	174	.....
10	94	70	319	44	32	135	14	93	58	31	118	.....
11	124	67	148	44	29	97	33	86	30	34	112	.....
12	124	61	76	50	28	74	118	46	30	134	56	.....
13	66	49	110	67	25	57	123	77	30	134	49	.....
14	41	43	104	122	25	48	49	129	30	96	42	.....
15	41	36	110	96	25	47	31	70	57	79	42	.....
16	44	36	81	69	22	39	20	62	82	62	42	.....
17	35	43	668	79	23	36	18	211	88	47	42	61
18	35	73	281	79	24	28	14	86	86	31	38	61
19	31	191	185	75	24	28	14	198	55	31	38	61
20	31	214	129	65	22	20	13	225	40	31	38	61
21	31	136	86	58	23	20	13	287	73	32	38	68
22	31	113	81	65	23	15	13	206	76	25	68	61
23	31	81	87	61	23	15	12	164	45	25	53	54
24	30	69	87	58	21	12	12	110	52	26	74	54
25	28	36	81	44	21	12	177	157	183	27	45	54
26	26	58	51	145	19	10	201	134	143	26	45	54
27	25	36	30	30	18	10	192	120	82	26	286	54
28	24	43	17	30	18	18	96	86	65	25	296	54
29	24	.....	15	50	18	16	61	69	55	24	.....	54
30	24	.....	100	75	18	16	61	62	48	23	.....	54
31	23	.....	89	.....	18	.....	55	69	.....	23	.....	54

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of San Pedro River at Charleston, Ariz., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	124	23	39.4	2,423
February	235	23	76.6	4,254
March	668	15	152	9,346
April	145	30	66.5	3,957
May	64	18	29.8	1,832
June	135	10	30.6	1,821
July	201	12	47.2	2,902
August (9-31)	287	46	125	5,702
September	219	30	80.4	4,784
October	134	17	40.7	2,502
November (1-28)	296	21	71.6	3,976
December (17-31)	68	54	57.3	1,705
The period				45,200

SALT RIVER AT ROOSEVELT, ARIZ.

This station was established February 7, 1901. It is located at the town of Roosevelt, which is the United States Reclamation Service construction camp for the Salt River dam and reservoir, and is about 12 miles west of Livingston, Ariz. The gage rod and cable are at the upper end of the gorge, about 2,000 feet below the mouth of Tonto Creek and 1,500 feet above the dam site.

Discharge measurements are made by means of a car suspended from a cable.

The gage is a vertical rod fastened to the rocks on the left bank of the river.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 66, pp 99-100; 85, p 25; 100, p 42; 133, p 212.
Discharge: 66, p 100; 85, pp 26-27; 100, pp 42-43; 133, pp 212-213.
Discharge, mean daily: 133, p 214.
Discharge, monthly: 75, p 178; 85, p 29; 100, p 45; 133, p 214.
Gage heights: 66, p 100; 85, p 28; 100, p 44; 133, p 213.
Rating table: 85, p 28.

Discharge measurements of Salt River at Roosevelt, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge	Date.	Hydrographer.	Gage height.	Discharge
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 4	Osburn Richins	21.00	30,360	February 4	Osburn Richins	23.50	[a]43,350
January 4	do	20.50	26,680	February 7	do	11.50	[a]6,872
January 4	do	23.50	38,530	February 14	do	9.60	3,424
January 4	do	16.00	16,200	February 17	do	17.40	[a]22,640
January 7	do	11.50	6,107	February 18	do	17.10	25,610
January 10	do	11.50	[a]3,189	February 18	do	16.80	[a]23,000
January 11	do	15.80	[a]12,600	February 23	do	10.90	[a]5,384
January 13	do	10.00	4,528	February 27	do	10.10	[a]5,166
January 18	do	8.10	742	February 28	do	11.80	11,790
January 21	do	8.10	751	February 28	do	15.95	[a]19,920
January 27	do	7.70	554	February 28	do	18.00	[a]28,120
February 4	do	16.00	[a]18,220	February 28	do	19.50	[a]33,430
February 4	do	21.00	[a]34,160	February 28	do	20.00	[a]36,340
February 4	do	20.50	[a]30,020	March 2	do	11.40	[a]11,610

[a] Float measurement.

Discharge measurements of Salt River at Roosevelt, Ariz., in 1905—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
March 10	Osburn Richins	11.55	[a]10,060	June 12	Osburn Richins	6.70	1,823
March 13	do	13.00	[a]13,540	June 13	do	6.50	1,762
March 14	do	20.50	[a]40,520	June 14	do	6.30	1,597
March 17	do	20.70	[a]41,380	June 16	do	6.10	1,378
March 18	do	19.70	[a]39,850	June 17	do	6.10	1,369
March 20	do	21.30	[a]51,130	June 19	do	5.85	1,216
March 24	do	10.50	11,000	June 20	do	5.70	1,079
March 29	do	9.50	6,748	June 21	do	5.60	938
April 4	do	13.70	14,600	June 22	do	5.55	905
April 6	do	12.00	7,154	June 23	do	5.45	877
April 10	do	12.40	7,908	June 24	do	5.40	864
April 12	Richins and Farish.	23.50	[a]43,560	June 26	do	5.30	808
				June 27	do	5.20	770
April 12	do	25.00	[a]47,620	June 28	do	5.15	733
April 13	do	20.00	40,230	June 29	do	5.10	715
April 14	do	12.90	19,030	June 30	do	5.05	687
April 15	do	11.80	13,370	July 1	do	5.05	687
April 16	do	11.40	11,500	July 7	do	4.60	455
April 18	Osburn Richins	10.00	8,875	July 8	do	4.50	415
April 20	do	10.15	9,262	July 10	do	4.40	374
April 22	do	9.60	8,335	July 12	do	4.30	344
April 24	do	10.95	11,050	July 13	do	4.40	358
April 25	do	11.85	13,920	July 14	do	4.30	383
April 26	do	11.75	13,840	July 15	do	4.30	337
April 27	do	11.10	11,470	July 17	do	4.60	427
April 28	do	10.90	9,814	July 18	do	4.50	400
May 1	do	10.50	9,524	July 19	do	4.50	392
May 3	do	10.60	9,534	July 20	do	4.35	363
May 4	do	10.20	8,390	July 22	do	4.40	402
May 5	do	9.80	6,522	July 24	do	4.50	406
May 6	do	9.30	5,811	August 1	do	5.20	656
May 10	do	9.30	5,471	August 2	do	5.00	603
May 11	do	9.00	5,606	August 4	do	4.60	554
May 12	do	8.80	4,956	August 5	do	4.40	522
May 13	do	8.60	4,269	August 7	do	4.50	523
May 15	Murphy and Richins	8.42	4,080	August 8	do	4.30	490
				August 10	do	5.30	654
May 17	Osburn Richins	8.40	4,026	August 11	do	5.90	736
May 18	do	8.40	4,043	August 12	do	5.10	603
May 19	do	8.45	4,155	August 14	do	4.90	536
May 20	do	8.35	4,012	August 15	do	4.70	461
May 22	do	7.90	3,299	August 17	do	4.80	471
May 23	do	7.80	3,131	August 18	do	4.70	430
May 24	do	7.65	2,846	August 19	do	4.50	391
May 25	do	7.50	2,841	August 21	do	5.50	774
May 27	do	7.30	2,420	August 22	do	4.70	452
May 29	do	7.00	2,272	August 23	do	7.20	2,490
May 31	do	6.70	1,921	August 25	do	6.70	1,578
June 2	do	6.55	1,840	August 26	do	5.20	705
June 5	do	6.70	1,957	August 28	do	5.00	527
June 7	do	6.50	1,701	August 30	do	5.20	392
June 8	do	6.60	1,881	August 31	do	5.10	337
June 9	do	7.20	2,414	September 1	do	5.00	340
June 10	do	7.10	2,275	September 2	do	5.30	374

[a] Float measurement.

Discharge measurements of Salt River at Roosevelt, Ariz., in 1905—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
September 4	Osburn Richins	5.20	741	November 8	E. O. Blades	6.60	2,045
September 6	do	6.65	2,031	November 9	do	5.40	1,292
September 8	do	5.40	913	November 10	do	5.00	791
September 9	do	4.70	762	November 11	do	4.80	715
September 11	do	4.60	653	November 13	do	4.50	638
September 12	do	4.40	612	November 14	do	4.40	587
September 14	do	4.20	448	November 15	do	4.30	510
September 16	do	4.00	316	November 16	do	4.20	539
September 18	do	3.80	315	November 17	do	4.20	524
September 20	do	3.80	292	November 18	do	4.15	491
September 22	do	3.60	227	November 20	do	4.10	471
September 25	do	6.15	1,252	November 21	do	4.15	484
September 26	do	6.30	1,321	November 22	do	6.75	3,168
September 30	do	6.90	1,414	November 23	do	6.55	2,230
October 2	do	5.60	710	November 24	do	6.75	2,660
October 3	do	5.30	574	November 25	do	6.50	1,827
October 4	do	5.10	500	December 5	do	7.65	2,497
October 5	do	4.90	385	December 6	do	7.55	2,347
October 7	do	4.70	261	December 7	do	7.45	1,993
October 9	do	4.40	283	December 8	do	7.35	1,762
October 11	do	4.20	231	December 9	do	7.30	1,561
October 19	do	4.00	316	December 11	do	7.10	1,341
October 20	do	3.90	297	December 12	do	7.10	1,276
October 21	do	3.90	302	December 13	do	7.00	1,149
October 23	Richins and Blades.	3.90	300	December 14	do	7.00	1,168
				December 15	do	6.90	1,091
October 24	do	3.80	308	December 16	do	6.90	981
October 25	do	3.80	307	December 18	do	6.80	888
October 26	E. O. Blades	3.80	335	December 19	do	6.80	869
October 27	do	3.80	320	December 20	do	6.80	865
October 28	do	3.80	331	December 21	do	7.00	1,041
October 30	do	3.80	314	December 22	do	7.00	1,213
October 31	do	3.80	304	December 23	do	6.95	945
November 1	do	3.80	305	December 26	do	6.60	697
November 2	do	3.80	299	December 27	do	6.70	829
November 3	do	3.80	306	December 28	do	6.80	887
November 6	do	4.25	628	December 29	do	6.80	945
November 7	do	4.20	610				

Daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.
1	6.91	7.65	14.8	10.0	10.5	6.55	5.0	5.2	5.05	6.15	3.8	8.75
2	6.91	7.85	12.1	10.3	10.6	6.52	4.9	4.95	5.15	5.6	3.8	8.5
3	6.91	8.95	11.0	11.35	10.6	6.45	4.85	4.75	6.05	5.2	3.8	8.1
4	6.9	21.0	10.8	13.2	10.25	6.72	4.8	4.55	4.95	5.05	3.8	7.85
5	6.9	16.25	11.05	12.6	9.75	6.7	4.7	4.4	5.5	4.9	3.95	7.65
6	6.9	15.4	11.1	11.6	9.25	6.7	4.6	4.45	6.4	4.75	4.25	7.55
7	6.9	12.0	10.9	11.9	9.0	6.5	4.6	4.45	5.65	4.65	4.2	7.45
8	6.9	10.15	10.6	11.9	9.0	6.62	4.5	4.3	5.3	4.45	6.65	7.55
9	7.46	9.45	10.9	12.15	9.2	7.2	4.45	4.2	4.8	4.3	5.4	7.3
10	12.75	9.35	11.45	12.6	9.25	7.05	4.4	5.15	4.75	4.2	5.0	7.2
11	15.65	8.85	11.4	16.2	9.0	6.85	4.4	5.75	4.65	4.2	4.75	7.1
12	13.5	11.75	10.35	23.5	8.75	6.65	4.3	5.15	4.5	4.1	4.65	7.0

Daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
13	9.9	10.1	15.5	22.5	8.6	6.5	4.35	4.95	4.5	4.0	4.5	7.0
14	9.0	9.5	19.95	13.35	8.5	6.25	4.3	4.9	4.2	4.0	4.4	7.0
15	8.65	9.3	14.1	11.9	8.42	6.2	4.3	4.7	4.0	4.0	4.3	6.9
16	8.55	9.92	12.5	10.9	8.4	6.1	4.6	4.8	4.0	4.0	4.2	6.9
17	8.45	17.35	20.25	9.9	8.4	6.1	4.6	4.75	3.9	4.0	4.2	6.8
18	8.35	16.70	19.35	9.9	8.4	5.9	4.45	4.7	3.8	4.0	4.15	6.8
19	8.25	11.45	14.65	9.9	8.42	5.82	4.5	4.6	3.8	4.0	4.1	6.8
20	8.13	10.35	19.65	10.15	8.3	5.7	4.5	4.5	3.8	3.9	4.1	6.8
21	8.1	9.7	14.0	9.75	8.07	5.6	4.5	5.15	3.7	3.9	4.15	7.0
22	8.04	9.5	10.9	9.55	7.87	5.55	4.45	4.6	3.6	3.9	6.75	7.0
23	7.97	10.25	10.25	9.85	7.75	5.42	4.4	6.8	3.6	3.9	6.55	6.95
24	7.88	11.75	10.35	11.4	7.62	5.4	4.5	5.15	5.45	3.8	6.75	6.85
25	7.84	10.47	9.85	11.65	7.5	5.35	4.5	6.35	5.55	3.8	6.4	6.72
26	7.77	10.18	9.8	11.6	7.4	5.3	4.5	5.4	5.9	3.8	7.5	6.6
27	7.71	10.1	9.7	11.0	7.27	5.15	4.5	5.25	5.1	3.8	26.7	6.7
28	7.68	17.95	9.5	10.9	7.15	5.12	6.1	5.0	5.0	3.8	17.3	6.8
29	7.65	.....	9.3	10.65	6.95	5.08	6.85	5.0	5.9	3.8	10.7	6.8
30	7.65	.....	9.45	10.5	6.8	5.05	5.7	5.15	6.8	3.8	9.4	6.8
31	7.65	.....	9.8	.....	6.7	.....	5.1	5.05	.....	3.8	.....	6.8

Daily discharge, in second-feet, of Salt River at Roosevelt, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1	172	526	17,100	7,548	9,350	1,800	650	655	380	1,132	313	8,700
2	172	625	12,150	8,076	9,700	1,770	600	590	460	710	313	4,700
3	172	3,900	9,250	9,819	9,700	1,700	575	572	1,497	527	313	3,670
4	165	31,400	8,925	12,020	8,475	1,970	550	545	526	480	313	3,620
5	165	18,800	11,300	8,937	6,738	1,950	500	522	1,000	385	420	2,497
6	165	16,700	11,330	6,495	5,675	1,950	455	523	1,806	310	628	2,347
7	165	8,250	11,220	6,989	5,175	1,750	455	515	1,136	250	610	1,993
8	165	4,500	11,060	6,989	5,175	1,870	415	490	891	250	2,210	1,762
9	346	3,145	11,220	7,437	5,575	2,450	395	475	783	260	1,292	1,561
10	5,900	2,959	11,540	8,937	5,675	2,300	375	612	772	230	790	1,451
11	12,300	2,037	11,500	20,040	5,175	2,100	375	705	707	230	695	1,341
12	9,460	8,306	8,200	43,350	4,675	1,900	345	612	632	217	67[illegible]	1,158
13	4,000	4,400	22,050	45,470	4,375	1,750	358	547	632	231	638	1,158
14	2,400	3,238	38,700	20,370	4,200	1,500	335	530	448	245	587	1,158
15	1,685	2,867	17,600	14,010	4,060	1,450	335	461	316	259	510	1,091
16	1,513	4,040	12,150	10,620	4,025	1,350	427	471	316	274	539	[illegible]
17	1,341	21,550	39,800	8,864	4,025	1,350	427	450	310	298	524	[illegible]
18	1,170	20,450	36,550	8,864	4,025	1,150	378	436	303	302	491	[illegible]
19	999	7,000	23,200	8,864	4,060	1,086	392	413	303	316	471	867
20	828	4,800	44,400	9,303	3,850	1,000	392	390	303	300	471	867
21	743	3,611	23,440	8,601	3,455	950	392	625	265	300	484	1,041
22	715	3,238	11,940	8,250	3,159	925	403	427	227	300	3,168	1,213
23	682	4,250	9,524	8,777	3,012	860	402	1,864	227	300	2,230	945
24	640	7,700	9,895	11,500	2,870	850	406	625	970	313	2,660	860
25	620	4,990	8,040	12,750	2,750	825	406	1,327	1,010	313	1,755	765
26	588	4,560	7,855	12,500	2,650	800	406	803	1,150	313	2,150	667
27	560	4,400	7,484	11,160	2,520	725	406	680	830	313	97,710	829
28	546	27,550	6,742	10,800	2,400	712	1,300	527	790	313	45,250	887
29	526	.....	6,000	9,906	2,200	690	2,000	527	1,150	313	14,050	945
30	526	.....	6,700	9,370	2,050	675	935	350	1,515	313	9,480	945
31	526	.....	7,300	.....	1,950	.....	617	325	.....	313	.....	945

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of Salt River at Roosevelt, Ariz., for 1905.

[Drainage area, 5,756 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	12,300	165	1,611	99,060	0.280	0.323
February	31,400	526	8,207	455,800	1.43	1.49
March	44,400	6,000	15,300	940,800	2.66	3.07
April	45,470	6,495	12,550	746,800	2.18	2.43
May	9,700	1,950	4,604	283,100	.800	.922
June	2,450	675	1,405	83,600	.244	.272
July	2,000	335	529	32,530	.092	.106
August	1,864	325	600	36,890	.104	.120
September	1,497	227	722	42,960	.125	.140
October	1,132	217	342	21,030	.059	.068
November	97,710	313	6,391	380,300	1.11	1.24
December	8,700	697	1,684	103,600	.293	.338
The year	97,710	217	4,495	3,226,000	.781	10.52

SALT RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897. It is located one-third mile above the junction of Salt and Verde rivers, 30 miles northeast of Phoenix, 15 miles northeast of Mesa, and 1¾ miles above the Arizona canal diversion dam.

The channel is straight for about 500 feet above the station. The right bank is about 3½ feet high at the water's edge and rises with a gradual slope for 400 feet; it is clean and is subject to overflow. The left bank rises vertically for about 5 feet, at which point there is a small bench, from which the rocks rise to a considerable height; this bank is clean and does not overflow. The bed of the stream is composed of sand and is shifting, and it is necessary to make a large number of measurements in order to obtain an accurate estimate of the discharge. The current is swift.

Discharge measurements are made by means of a cable and car. The initial point for soundings is 120 feet south of the standard under the cable at the north bank. Low-water measurements are made by wading about 1,000 feet upstream from the cable, where a tag wire has been placed.

Gage heights and measurements are taken by W. Richins, who devotes his whole time to the work. There have been five gages in use at this station, as follows:

Gage No. 1, set April 20, 1897, was a 2- by 6-inch timber bolted to the rocks on the south bank of the river, about one-fourth mile above the cable. This gage, which has since been removed, was used until November 30, 1899, when the station was temporarily abandoned. The bench mark is a nail in a palo verde tree about 75 feet west of the cable anchorage on the north bank; elevation, 17.33 feet above the zero of the gage.

Gage No. 2 was established in 1901. It consists of a 2- by 6-inch timber fastened to a tree on the north bank of the river three-fourths mile above the cable. The zero of this gage is 1,323.54 feet above sea level. Its bench mark is a nail in a root of a willow tree, to which the gage is fastened; elevation, 1,328.69 feet above sea level, and 5.10 feet above the zero of the gage. On April 2, 1903, high water in Verde River backed up the water on gage No. 2 and changed the cross section by depositing sand.

Gage No. 3 was installed May 19, 1903. It consists of a 1- by 6-inch stadia rod spiked to a 2- by 4-inch timber and fastened to a tree on the south bank 1½ miles above the cable. The water surface at this gage is about 15 feet higher than at the mouth of the Verde River,

and the zero of the gage is 1,336.27 feet above sea level. Three bench marks have been established for this gage, as follows: (1) A nail in a mesquite stump 200 feet east of Peters's corral; elevation, 1,363.2 feet above sea level and 26.93 feet above the zero of the gage. (2) A nail in the root of a mesquite tree on top of the bank 50 feet northwest of the northwest corner of Peters's corral and about 75 feet from the gage; elevation, 1,356 feet above sea level and 19.73 feet above the zero of the gage. (3) A nail in the willow tree to which the gage is attached; elevation, 1,344.27 feet above sea level and 8.00 feet above the zero of the gage.

Gage No. 4 was a temporary gage on the north side of the river about 600 yards above the section and was read in conjunction with gage No. 3. This temporary gage, No. 4, was washed out by heavy floods early in 1905.

Gage No. 5 was established because of the difficulty and time involved in reaching gage No. 3 during high water and also because the river had changed its channel in such a way as to leave gage No. 3 dry. It was located on the right bank of the river about one-fourth mile below the location of No. 3. No. 5 was read from March 10, the date of its establishment, to March 20, 1905, on which date it was destroyed.

The river swept back to gage No. 3, which was used until April 14, when another change of channel rendered No. 3 useless. A temporary gage was then established at the old location of No. 4. This was observed until September 1, 1905, when a permanent gage was established. The zero of this gage is at an elevation of 1,326.62 feet above sea level and is referred to two bench marks: (1) On a mesquite tree 200 feet northwest of the gage; elevation, 1,346.12 feet above sea level. (2) A nail in tree at gage; elevation, 1,336.37 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 418-419, 420-421; WS 16, p 148; 28, p 133; 38, p 321; 50, pp 386-387; 66, p 101; 85, pp 23-24; 100, pp 36-37; 133, pp 215-216.
Discharge: Ann 19, iv, p 419; WS 16, p 148; 28, p 143; 38, p 321; 66, p 102; 85, p 24; 100, pp 38-39; 133, pp 215-216.
Discharge, mean daily: WS 133, p 220.
Discharge, monthly: Ann 20, iv, p 406; 21, iv, p 386; WS 75, p 179; 85, p 25; 100, pp 40-41; 133, p 221.
Discharge, yearly: Ann 20, iv, p 59.
Gage heights: WS 16, p 149; 28, p 140; 38, p 322; 66, p 102; 85, p 25; 100, p 40; 133, p 219.
Hydrographs: Ann 19, iv, p 423; 20, iv, p 406; 21, iv, p 387.
Rating tables: Ann 19, iv, p 419; WS 28, p 145; 100 pp 40-41.

Discharge measurements of Salt River at McDowell, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 11	W. Richins	9.30	18,500	March 11	W. Richins	5.68	9,981
January 13	do	5.25	5,134	March 14	do	10.20	[a]29,040
January 16	do	3.25	1,235	March 17	do	11.20	[a]37,970
January 20	do	2.95	1,110	March 29	do	6.05	6,355
January 24	do	2.44	569	March 31	do	6.00	6,441
January 27	do	2.37	477	April 4	do	6.55	7,657
January 31	do	2.32	439	April 5	do	6.55	9,070
February 3	do	3.70	1,474	April 12	do	10.60	60,570
February 4	do	12.10	[a]43,280	April 13	do	10.20	54,190
February 7	do	7.95	13,890	April 14	do		21,840
February 10	do	5.00	4,797	April 19	do	4.40	9,756
February 14	do	4.83	4,464	April 21	do	4.30	9,667
February 17	do	9.50	25,560	April 25	do	5.20	15,990
February 21	do	5.00	6,207	April 28	do	4.50	11,920
February 24	do	6.75	10,150	May 2	do	4.35	10,680
March 1	do	8.65	24,780	May 5	do	3.65	8,173
March 8	do	5.40	[b]8,406	May 10	do	3.42	7,427

[a]Flat measurement. [b]Gage height of new gage No. 4=5.9.

Discharge measurements of Salt River at McDowell, Ariz., in 1905—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 12	W. Richins	2.92	5,604	July 29	W. Richins	−0.35	874
May 16	do	2.50	4,329	August 1	do	− .26	752
May 19	do	2.40	4,243	August 3	do	− .05	546
May 23	do	1.85	3,327	August 5	do	− .04	493
May 24	do	1.75	3,149	August 8	do	− .06	463
May 26	do	1.57	2,889	August 10	do	− .08	557
May 30	do	1.30	2,228	August 16	do	− .20	445
May 31	do	1.25	2,066	August 22	do	− .0[illegible]	507
June 2	do	1.20	1,848	August 24	do	.50	1,098
June 6	do	1.28	1,888	August 29	do	− .10	457
June 7	do	1.20	1,838	August 31	do	− .28	354
June 9	do	1.77	2,859	September 2	do	5.03	[a] 1,815
June 12	do	1.25	2,077	September 5	do	4.25	781
June 13	do	1.12	1,861	September 7	do	5.18	1,993
June 14	do	.92	1,600	September 9	do	4.30	842
June 15	do	.83	1,683	September 12	do	4.03	640
June 16	do	.80	1,532	September 15	do	3.80	458
June 17	do	.78	1,336	September 19	do	3.56	330
June 19	do	.65	1,210	September 21	do	3.50	302
June 20	do	.63	1,155	September 23	do	3.45	266
June 21	do	.60	1,081	September 26	do	4.90	1,614
June 22	do	.55	1,000	September 30	do	5.15	1,995
June 23	do	.49	968	October 4	do	4.14	718
June 24	do	.45	860	October 7	do	3.88	477
June 26	do	.42	819	October 10	do	3.70	374
June 27	do	.39	776	October 12	do	3.63	339
June 28	do	.37	791	October 14	do	3.60	350
June 29	do	.35	716	October 17	do	3.55	315
June 30	do	.31	676	October 19	do	3.52	311
July 1	do	.29	684	October 21	do	3.50	289
July 3	do	.18	575	October 26	do	3.52	297
July 4	do	.16	526	October 28	do	3.52	302
July 5	do	.12	521	October 31	do	3.50	284
July 6	do	.08	496	November 2	do	3.47	300
July 7	do	.02	460	November 4	do	3.50	308
July 8	do	−.04	459	November 7	do	3.90	515
July 11	do	−.17	368	November 9	do	5.25	1,843
July 13	do	−.26	345	November 11	do	4.12	665
July 15	do	−.02	481	November 14	do	4.02	534
July 18	do	−.12	428	November 16	do	3.90	495
July 20	do	−.24	370	November 18	do	3.84	460
July 22	do	−.25	355	November 22	do	4.50	1,045
July 25	do	−.13	445	November 24	do	5.25	2,219
July 27	do	−.17	415				

[a] Gage readings are from rod No. 4. Four feet on this rod is the same as zero on the other. All subsequent readings are from this rod.

Daily gage height, in feet, of Salt River at McDowell, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.82	2.32	9.5	5.9	4.2	1.2	0.28	0.25	3.68	[a] 4.9	3.47	[b] 6.8
2	1.82	2.32	6.65	6.35	4.35	1.2	.25	.15	5.05	[a] 4.62	3.47	6.7
3	1.82	3.8	6.05	6.0	4.3	1.2	.2	.03	[a] 4.0	4.22	3.47	6.3
4	1.82	10.25	5.25	6.85	4.05	1.25	.16	.09	4.47	4.12	3.5	6.1
5	1.82	10.9	5.2	6.55	3.65	1.32	.11	−.04	4.52	4.02	[a] 3.66	6.3
6	1.81	9.15	5.35	6.2	3.3	1.26	.06	−.05	4.33	3.94	3.76	6.15
7	1.8	8.05	5.23	6.2	3.35	1.2	.02	−.05	5.05	3.86	3.92	6.09
8	1.82	6.6	5.07	6.05	3.4	1.18	−.05	−.08	4.55	[a] 3.8	4.75	5.92
9	1.85	5.85	4.95	5.85	3.2	1.72	−.09	−.05	4.3	3.75	5.12	5.85
10	8.9	5.15	5.75	5.9	3.37	1.5	−.14	+.06	[a] 4.12	3.68	4.32	5.68
11	9.3	5.05	5.85	5.35	3.15	1.5	−.18	+.03	4.03	3.64	4.12	5.62
12	7.35	5.7	4.57	10.3	2.87	1.28	−.24	.24	4.01	3.62	[a] 4.1	5.56
13	5.2	5.5	6.18	10.6	2.75	1.12	−.14	.03	3.92	3.6	4.08	5.5
14	3.85	4.8	10.1	6.75	2.7	.96	−.23	−.03	3.85	3.6	4.01	5.4
15	3.2	4.25	7.62	5.6	2.5	.84	−.01	−.14	3.77	[a] 3.58	3.94	5.36
16	3.2	4.7	5.78	4.95	2.45	.81	−.03	−.21	3.74	3.56	3.89	5.32
17	3.1	9.2	10.85	4.85	2.42	.78	−.08	−.22	[a] 3.67	3.54	3.87	[a] 5.25
18	3.2	9.65	10.85	4.6	2.45	.67	−.14	−.26	3.6	3.53	3.84	5.22
19	3.15	7.6	9.3	4.35	2.38	.68	−.2	−.23	3.54	3.52	[a] 3.82	5.14
20	2.95	6.1	10.0	4.5	2.3	.62	−.26	−.22	3.52	3.51	3.81	5.1
21	2.9	4.9	9.25	4.25	2.25	.58	−.3	−.21	3.49	3.5	3.88	5.46
22	2.78	4.1	8.25	3.9	2.0	.54	−.25	−.03	3.46	[a] 3.53	4.95	5.68
23	2.6	4.35	7.4	3.85	1.82	.48	−.22	.58	3.45	3.53	5.5	5.22
24	2.44	6.45	6.82	4.7	1.72	.44	−.15	.50	[a] 5.9	3.53	5.2	[a] 5.35
25	2.41	5.8	6.51	5.1	1.65	.42	−.14	.35	5.0	3.52	5.4	5.1
26	2.38	5.45	6.4	5.1	1.58	.42	−.13	.4	5.02	3.51	[b] 6.0	5.1
27	2.37	4.45	6.35	4.6	1.45	.38	−.19	.18	4.32	3.5	[b] 21.2	5.0
28	2.37	8.65	6.33	4.5	1.43	.36	+.32	.05	4.03	3.52	[b] 15.0	5.02
29	2.35	.....	6.13	4.3	1.38	.33	.35	−.12	3.97	[a] 3.5	[b] 10.0	5.04
30	2.34	.....	5.75	4.2	1.28	.3	1.5	−.23	[a] 5.32	3.5	[b] 7.5	5.05
31	2.32	.....	5.95	.....	1.25	.....	.63	−.28	.....	3.49	.....	5.0

[a] Interpolated gage heights.
[b] Approximate flood heights during time gage was out.

NOTE.—Several gages used during the year. See station description.

Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	184	527	29,060	5,678	10,140	2,020	660	735	380	1,635	275	6,000
2	184	527	14,700	8,026	10,760	2,020	630	635	1,838	1,262	275	5,160
3	184	1,576	11,680	6,200	10,560	2,020	580	530	595	764	275	4,170
4	184	26,860	7,651	10,636	9,579	2,200	552	575	1,061	685	290	3,430
5	184	32,320	7,399	9,070	8,192	2,237	517	493	1,127	610	370	4,170
6	177	17,870	8,154	7,244	6,976	2,128	486	475	879	550	426	3,600
7	170	14,280	7,530	7,244	7,155	2,020	462	475	1,838	492	535	3,350
8	184	9,544	6,745	6,460	7,323	1,984	420	450	1,168	450	1,438	2,750
9	205	7,095	6,140	5,417	6,629	2,977	396	515	840	420	1,936	2,500
10	17,050	3,882	11,720	5,678	7,219	2,570	376	685	685	380	970	1,815
11	18,870	3,632	12,100	4,366	6,457	2,570	362	650	617	360	665	1,625
12	11,990	6,606	7,121	55,080	5,484	2,164	351	895	602	350	670	1,540
13	5,008	5,953	13,390	60,600	5,093	1,876	376	640	535	340	655	1,400
14	1,663	3,006	28,650	22,720	4,945	1,616	352	570	485	340	534	1,380

Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	1,132	2,626	19,000	17,850	4,430	1,430	483	485	432	330	490	1,340
16	1,132	3,755	11,830	14,420	4,335	1,385	475	440	414	320	490	1,300
17	1,063	24,650	34,850	13,760	4,278	1,340	445	425	365	310	490	1,228
18	1,132	26,630	34,850	12,100	4,335	1,178	410	400	340	305	445	1,195
19	1,097	17,620	25,540	10,760	4,202	1,192	390	415	310	300	455	1,120
20	959	11,040	28,260	11,530	4,050	1,108	365	415	300	295	450	1,075
21	926	5,768	35,800	10,350	3,958	1,050	350	415	285	290	505	1,440
22	843	2,250	17,940	9,058	3,495	990	355	565	270	305	975	1,820
23	720	3,354	13,510	8,884	3,162	904	377	1,180	265	305	3,176	1,495
24	609	9,471	10,480	12,760	2,977	852	425	1,100	4,220	305	2,060	1,330
25	589	8,008	8,861	15,420	2,847	826	440	860	1,770	300	2,903	1,075
26	568	7,220	8,287	15,420	2,718	826	440	920	1,797	295	4,545	1,075
27	561	3,792	8,027	12,100	2,477	776	395	660	866	290	138,000	975
28	561	24,780	7,922	11,530	2,441	752	830	550	610	300	83,530	990
29	547	.....	6,878	10,560	2,348	716	874	445	580	290	33,100	1,020
30	541	.....	5,066	10,140	2,164	680	2,780	375	2,430	290	17,710	1,030
31	527	.....	5,939	.....	2,110	.....	1,260	355	.....	285	.....	975

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly dischagre of Salt River at McDowell, Ariz., for 1905.

[Drainage area, 6,260 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	18,870	170	2,250	138,300	0.359	0.414
February	32,320	527	10,170	564,800	1.62	1.69
March	35,800	5,066	14,680	902,600	2.35	2.71
April	60,600	4,366	13,700	815,200	2.19	2.44
May	10,760	2,110	5,253	323,000	.839	.967
June	2,977	680	1,547	92,050	.247	.276
July	2,780	350	568	34,920	.091	.105
August	1,180	355	591	36,340	.094	.108
September	4,220	265	930	55,340	.149	.166
October	1,635	285	444	27,300	.071	.082
November	138,000	275	9,954	592,300	1.59	1.77
December	6,000	975	2,047	125,900	.327	.377
The year	138,000	170	5,178	3,708,000	.827	11.10

VERDE RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897. It is located 30 miles northeast of Phoenix, 15 miles northeast of Mesa, 2⅛ miles above the Arizona Canal diversion dam, and three-fourths mile above the mouth of the river.

The channel is straight for 300 feet above and below the station, with a width of 100 feet at low water and 450 feet at high water. The right bank is high, rocky, and clean, and is not subject to overflow; the left bank is low, clean, and is lbiale to overflow. The bed of the stream is composed of sand and is shifting. The current is swift.

Discharge measurements are made by means of a cable, car, and tagged wire. At low water the channel is oblique to the gaging section and measurements are made by wading at a point 400 feet above the cable.

Gage heights are observed by W. Richins. Three gages have been in use at this station, as follows:

Gage No. 1, established April 20, 1897, consisted of a vertical rod attached to a large cottonwood tree on the east bank about 60 feet below the cable. This was read until November 11, 1899, when the station was temporarily abandoned. The bench mark is a point on a cat's claw (acacia) tree about 100 feet southeast of the gage; elevation, 27.02 feet above the zero of the gage.

Gage No. 2 was established in January, 1901, and observations were resumed. It is an inclined 2- by 4-inch timber, fastened to the rocks on the west bank about 500 feet above the cable, the zero of the gage being 1,325.4 feet above sea level. Three bench marks were established for this gage, as follows: (1) A nail in a mesquite tree about 6 feet below the cable anchorage on the east bank; elevation, 1,345.5 feet above sea level, and 20.10 feet above the zero of the gage. (2) A nail in the cable standard at the east bank; elevation, 1,341.3 feet above sea level, and 15.90 feet above the zero of the gage. (3) A mark on rock at the gage; elevation, 1,330.4 feet above sea level, and 5.00 feet above the zero of the gage.

Gage No. 3 was established May 16, 1904, on account of water piling up at No. 2 during flood. It is a vertical rod fastened to a willow tree on the east bank about one-half mile above the cable. The zero of the gage is 1,339.26 feet above sea level. Two bench marks were established for this gage: (1) A nail in a large cottonwood tree on the top of the east bank near the gage; elevation, 1,354.11 feet above sea level, 14.85 feet above the zero of the gage. (2) A nail in the willow tree to which the gage is attached; elevation, 1,347.26 feet above sea level, and 8.00 feet above the zero of the gage.

Gage No. 3, with the tree to which it was attached, was washed out during the heavy flood February 25, 1905. As the water showed no tendency to pile up at Gage No. 2, readings were resumed on that gage, which was used to the end of the year.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report, Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 420-421; Bull 131, p 49; WS 16, p 150, 28 p 133; 38, p 323; 50 p 387; 66, pp 102-103, 85, p 21; 100, pp 31-32; 133, pp 222-223.

Discharge: WS 16, p 150; 38, p 323, 66, p 103; 85, p 22; 100, pp 33-34; 133, pp 223-226.

Discharge, mean daily: WS 133, p 227.

Discharge, monthly: Ann 11, ii, p 100; 19, iv, p 423; 20, iv, p 407, 21, iv, p 387; WS 75, p 177; 100, p 36; 133, p 227.

Discharge, yearly: Ann 20, iv, p 59.

Gage heights: Bull 131, p 51; WS 16, p 150; 28, pp 141,143; 38 p 324; 66, p 103; 85, p 23; 100, p 35; 133, p 226.

Hydrographs: Ann 19, iv, p 423; 20, iv, p 407; 21, iv, p 388; WS 75, p 177.

Rating table: Ann 19, iv, p 422.

Discharge measurements of Verde River at McDowell, Ariz., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 11	W. Richins	7.00	9,159	February 14	W. Richins	3.90	[a] 1,648
January 13	do	3.70	2,183	February 17	do	7.60	[a] 8,174
January 16	do	2.65	876	February 21	do	5.90	4,195
January 20	do	2.62	739	February 24	do	9.70	11,670
January 24	do	2.30	612	March 1	do	14.5	23,290
January 27	do	2.25	580	March 6	do	8.75	5,440
January 31	do	2.18	462	March 11	do	6.95	2,617
February 4	do	13.20	32,990	March 14 [a]	do	16.0	28,850
February 7	do	7.75	7,921	March 17 [a]	do	17.0	31,080
February 10	do	4.60	2,706	March 29	do	7.75	2,973

[a] Float measurement.

Discharge measurements of Verde River at McDowell, Ariz., in 1905—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
March 31	W. Richins	7.00	1,954	July 25	W. Richins	3.70	178
April 4	do	6.70	1,341	July 27	do	3.70	180
April 5	Parish and Richins.	6.6	1,363	July 29	do	4.83	668
April 5	do	6.6	1,393	August 1	do	4.50	517
April 6	do	6.65	1,383	August 3	do	4.38	436
April 6	do	6.65	1,436	August 5	do	4.10	330
April 6	do	6.65	1,448	August 8	do	4.00	291
April 12	Richins and Earle	19.0	35,550	August 10	do	4.67	540
April 14	W. Richins	11.4	15,110	August 12	do	5.00	737
April 21	do	6.8	3,115	August 16	do	4.25	372
April 21	do	6.3	2,041	August 22	do	4.20	333
April 25	do	6.15	1,604	August 24	do	4.95	764
April 28	do	6.2	1,797	August 29	do	5.07	746
May 2	do	5.76	1,195	August 31	do	4.70	491
May 5	do	5.4	980	September 2	do	4.73	521
May 10	do	5.8	1,282	September 5	do	4.45	426
May 12	do	5.4	989	September 7	do	6.90	2,961
May 19	do	4.70	640	September 9	do	5.40	1,046
May 23	do	4.48	470	September 12	do	4.65	426
May 25	do	4.45	428	September 15	do	4.38	391
May 26	do	4.4	408	September 19	do	4.15	302
May 30	W. B. Richins	4.3	389	September 21	do	4.00	280
June 1	do	4.3	389	September 23	do	4.00	275
June 2	do	4.25	385	September 26	do	5.23	975
June 6	do	4.13	410	September 30	do	8.80	5,899
June 8	do	4.1	358	October 4	do	4.70	675
June 9	do	4.15	334	October 7	do	4.35	404
June 12	do	4.05	291	October 10	do	4.20	364
June 13	W. Richins	4.03	279	October 12	do	4.10	361
June 15	do	3.98	278	October 14	do	4.08	321
June 17	do	3.95	299	October 17	do	4.05	302
June 20	do	3.91	245	October 19	do	4.02	316
June 22	do	3.86	237	October 21	do	4.0	293
June 24	do	3.81	237	October 26	do	4.01	308
June 27	do	3.75	188	October 28	do	4.03	319
June 29	do	3.72	191	October 31	do	4.01	311
July 1	do	3.7	205	November 2	do	3.96	328
July 4	do	3.61	157	November 4	do	3.99	301
July 6	do	3.58	131	November 7	do	4.20	392
July 8	do	3.57	132	November 9	do	5.70	1,885
July 11	do	3.56	128	November 11	do	5.15	1,168
July 13	do	3.55	132	November 14	do	4.45	622
July 15	do	4.12	323	November 16	do	4.35	466
July 18	do	3.80	243	November 18	do	4.3	415
July 20	do	3.70	181	November 22	do	4.5	504
July 22	do	3.61	158	November 24	do	5.0	1,012

Daily gage height, in feet, of Verde River at McDowell, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.08	2.16	15.0	[a]6.9	5.85	4.25	3.7	4.45	4.98	[b]7.4	4.01	[a]6.6
2	1.09	2.18	11.35	6.82	5.65	4.22	[b]3.6	4.39	[a]4.75	[b]5.95	4.01	[a]5.9
3	1.08	2.74	10.45	6.75	5.55	4.2	3.63	4.31	[b]4.65	4.92	4.0	5.3
4	1.06	13.25	10.1	6.68	5.48	[b]4.15	3.6	4.19	4.55	4.68	[a]3.99	4.95
5	1.05	13.25	9.75	6.6	5.4	4.13	3.57	[a]4.1	4.4	4.52	[b]4.05	4.7
6	1.05	10.25	9.0	6.65	5.45	4.12	3.57	[b]4.08	5.53	4.42	4.12	4.45
7	[a]1.05	8.15	8.65	6.65	[a]5.45	4.1	3.57	4.02	6.65	4.32	4.5	4.32
8	[b]1.15	6.4	8.4	6.62	6.0	4.1	3.56	3.98	5.62	[b]4.25	5.12	4.22
9	1.25	5.3	7.8	6.6	6.15	4.13	[b]3.55	4.75	[a]5.4	4.22	5.62	[a]4.2
10	6.75	4.6	7.38	6.66	5.7	[a]3.98	3.56	4.75	[b]4.65	4.18	5.45	[a]4.0
11	7.4	[a]4.62	6.95	9.4	5.5	[b]4.0	3.55	5.08	4.75	4.12	[a]5.15	4.0
12	6.15	[a]5.4	6.9	17.75	5.32	4.05	3.54	5.2	4.62	4.09	[b]4.8	3.92
13	3.8	[a]4.8	9.85	15.0	6.1	4.02	3.56	4.63	4.52	4.09	4.6	3.9
14	3.1	3.85	15.1	11.4	[a]5.7	3.97	3.68	[a]4.5	4.42	[a]4.08	4.45	3.82
15	2.85	3.55	11.35	10.85	5.25	3.97	[a]4.1	4.35	4.36	[b]4.07	4.38	3.7
16	2.65	3.5	11.45	9.7	4.95	3.97	[b]3.95	4.28	[a]4.3	4.06	4.35	[a]3.75
17	2.55	6.1	16.25	8.5	4.85	3.95	3.88	4.25	[b]4.21	4.03	4.32	[b]3.7
18	2.85	8.6	14.55	7.7	4.75	3.9	3.79	4.3	4.12	4.01	[a]4.3	3.68
19	2.72	7.95	[a]12.0	7.0	4.68	[b]3.9	3.73	[a]4.15	4.12	4.02	[b]4.27	3.66
20	2.59	6.5	[b]11.4	6.45	4.65	3.9	3.68	4.08	4.08	4.0	4.25	3.6
21	[a]2.5	5.85	[b]10.8	6.25	[a]4.6	3.85	3.63	4.05	4.0	[a]4.0	4.35	3.73
22	[b]2.41	5.45	[b]10.2	[a]6.1	4.52	3.85	[a]3.61	4.18	4.0	[b]4.0	4.6	3.70
23	2.32	6.2	[b]9.6	[b]6.1	4.46	3.82	[b]3.62	5.0	[a]4.0	4.0	5.0	3.82
24	2.28	12.0	[a]9.0	6.2	4.42	3.8	3.64	4.9	4.3	4.0	4.98	[b]3.75
25	2.26	[b]9.1	8.75	6.5	[b]4.42	3.78	3.68	5.52	4.75	4.02	[a]4.95	[a]3.68
26	2.29	[b]8.2	[a]8.6	6.85	4.38	3.76	3.65	[a]6.1	5.02	4.0	[b]5.5	3.65
27	2.27	8.25	[b]8.2	6.35	4.35	3.74	3.68	[b]5.7	4.8	4.0	17.0	3.64
28	2.27	14.0	[a]7.8	6.2	[a]4.32	3.72	4.4	5.25	4.85	[a]4.03	[b]10.0	3.63
29	2.25	.....	7.6	[a]6.1	4.28	3.71	[a]4.85	5.02	5.4	[b]4.0	[b]8.0	3.61
30	[b]2.2	.....	7.15	[b]6.0	4.27	3.69	[a]5.5	4.85	8.45	3.99	[a]7.2	3.61
31	2.16	.....	6.95	.....	4.27	.....	4.85	4.65	.....	4.01	.....	[b]3.61

[a] One gage reading. [b] Estimated.

NOTE. Gage changes from No. 3 to No. 2 February 24.

Daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	248	499	25,130	1,819	1,342	370	205	490	720	4,080	325	3,290
2	250	507	10,580	1,710	1,145	370	185	452	535	2,200	340	2,400
3	248	968	8,800	1,615	1,082	380	173	403	490	920	321	1,850
4	243	32,970	8,107	1,520	1,037	380	155	365	455	665	301	1,555
5	241	32,970	7,414	1,411	987	385	137	330	410	515	325	1,310
6	241	19,310	5,928	1,478	1,018	400	132	325	1,200	440	355	1,085
7	241	9,743	5,276	1,478	1,018	380	132	297	2,550	390	575	981
8	263	5,400	4,884	1,439	1,507	358	130	285	1,270	370	1,200	905
9	285	3,750	3,946	1,411	1,696	335	128	630	1,046	360	1,775	830
10	8,674	2,700	3,289	1,493	1,177	277	130	585	475	355	1,550	750
11	10,060	2,730	2,617	6,433	1,050	283	128	785	535	355	1,168	750
12	7,394	3,900	2,539	32,140	949	291	125	860	410	355	865	694
13	2,379	3,000	7,612	24,640	1,655	280	130	525	400	340	700	636
14	1,400	1,637	25 500	15,160	1,205	270	164	455	385	321	622	622

Daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1905—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
15	1,100	1,403	10,580	13,720	925	275	315	404	380	318	525	596
16	860	1,367	10,780	10,710	760	290	280	385	366	305	466	590
17	755	4,950	29.410	7,566	715	300	262	364	325	298	435	560
18	1,100	9,767	23,460	5,471	660	267	240	383	300	300	415	548
19	944	8,641	12,120	3,639	630	255	207	327	297	316	400	536
20	791	6,130	10,630	2,337	600	237	175	315	293	298	383	536
21	710	5,004	9,368	1,893	555	230	165	280	275	293	423	578
22	642	4,311	8,110	1,617	495	235	158	327	275	296	580	596
23	583	5,010	6,855	1,617	440	230	160	753	275	300	1,000	632
24	559	12,170	5,594	1,782	422	230	165	735	345	303	1,000	590
25	548	6 126	5.070	2,448	415	217	175	1,085	570	306	955	548
26	564	4,572	4,755	3,246	400	200	165	1,617	805	305	1,610	530
27	553	4,650	3,916	2,115	390	183	175	1,160	625	305	[a]61,460	524
28	553	21,050	3,077	1,782	380	187	435	870	650	319	13,115	518
29	542	.....	2,770	1,617	375	190	685	715	1,125	305	5,520	506
30	515	.....	2,158	1,507	375	192	1,080	590	5,350	305	4,240	506
31	499	.....	1,887	.....	375	.....	710	465	.....	311	.....	506

[a] Calculated from Kutter's formula.

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of Verde River at McDowell, Ariz., for 1905.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum	Mean.		Second-feet per square mile.	Depth in inches.
January	10,060	241	1,419	87,250	0.236	0.272
February	32,970	499	7,709	428,100	1.28	1.33
March	29,410	1,887	8,780	539,900	1.46	1.68
April	32,140	1,411	5,227	311,000	.871	.972
May	1,696	375	832	51,160	.139	.160
June	400	183	283	16,840	.047	.052
July	1,080	125	245	15,060	.041	.047
August	1,617	280	567	34,860	.094	.108
September	5,350	275	771	45,880	.128	.143
October	4,080	293	544	33,450	.091	.105
November	61,460	301	3,432	204,200	.572	.638
December	3,280	506	875	53,800	.146	.168
The year	61,460	125	2,557	1,822,000	.426	5.68

SANTA CRUZ RIVER AT TUCSON, ARIZ.

This station was established October 15, 1905, by G. E. P. Smith. It is located at Congress Street Bridge, Tucson, Ariz.

The channel is straight for 500 feet above and 300 feet below the station. The current is swift. The left bank is low, wooded, and liable to overflow. The right bank is about 12 feet high and not liable to overflow. The bed of the stream is composed of bowlders, and shifts during floods.

Discharge measurements are made from the bridge, which consists of one steel span 100 feet long and four pile bents each 15 feet long. The initial point for soundings is the east edge of upstream cylindrical pier on the west bank.

The gage is painted on the pier, which is taken as the initial point. During 1905 the gage was read twice each day by George S. Calliahan.

Discharge measurements of Santa Cruz River at Tucson, Ariz., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
November 27	G. E. P. Smith	68	46	5.40	1.58	251
November 28	do	90	317	7.90	3.60	2,515
December 27	do	44	17	2.40	0.65	40

Daily gage height, in feet, of Santa Cruz River at Tucson, Ariz., for 1905.

Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		1.0	25	1.3	
2		1.0	26	1.1	
8	1.65		27	1.38	
9	1.25		28	3.85	
22	1.65		29	2.4	
23	1.20		30	1.45	
24	2.0				

NOTE.—All water taken out by canals heading above station, leaving the river channel dry at station except on days for which gage heights are recorded.

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 175.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States—folios and separate sheets thereof; (8) Geologic Atlas of United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Braly Building; San Francisco Cal., 432 Merchants' Exchange Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Great Falls, Mont.; Hazen, Nev.; Boise, Idaho; Spokane, Wash., 424 Peyton Block; Pendleton, Oreg.

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WASHINGTON, D. C.

SEPTEMBER, 1906.

O

Water-Supply and Irrigation Paper No. 176 Series P, Hydrographic Progress Reports, 52

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART XII.—The Great Basin Drainage

BY

M. C. HINDERLIDER, G. L. SWENDSEN, and HENRY THURTELL

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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART XII.

By M. C. HINDERLIDER, G. L. SWENDSEN, and HENRY THURTELL.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200.000
1900[1]	50,000	1906	200.000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention.

In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay, and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

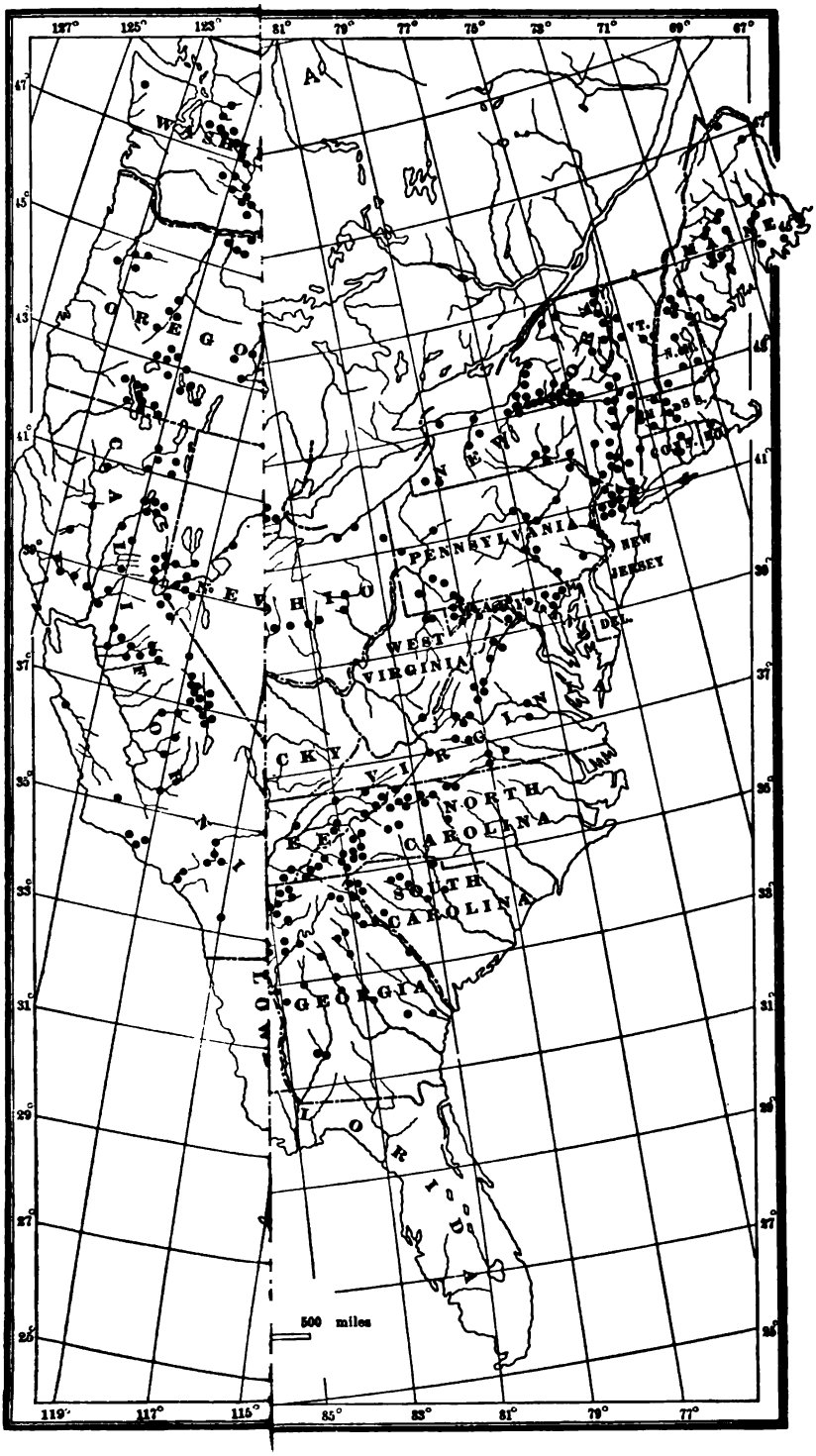
Drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogechee.
Neuse.	Altamaha.
Cape Fear.	Minor Southern Atlantic.


PENNSYLVANIA
NEW JERSEY
DEL.
WEST VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
500 miles

DURING 1905.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent the rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest; this is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than that given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two, and not more than four, significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example. 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5 and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5 and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25, 0.125, 0.012, 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep; 13.572 inches deep.
1 second-foot for one year equals 0.000..14 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equals 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal .223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.
To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$=Net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:

Scale 1:125000, 1 mile=0.50688 inch.
Scale 1:90000, 1 mile=0.70400 inch.
Scale 1:62500, 1 mile=1.01376 inches.
Scale 1:45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given.

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{r\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n, which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope, as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions, and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

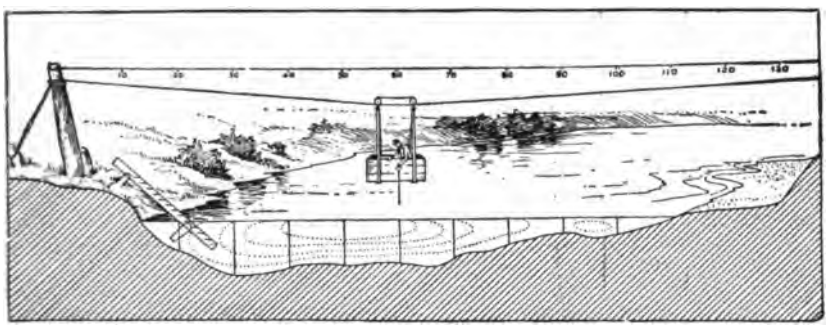


FIG. 1.—Cable station showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared, which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading; and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity curve, 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as

shown in fig, 1. and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pages 141-148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

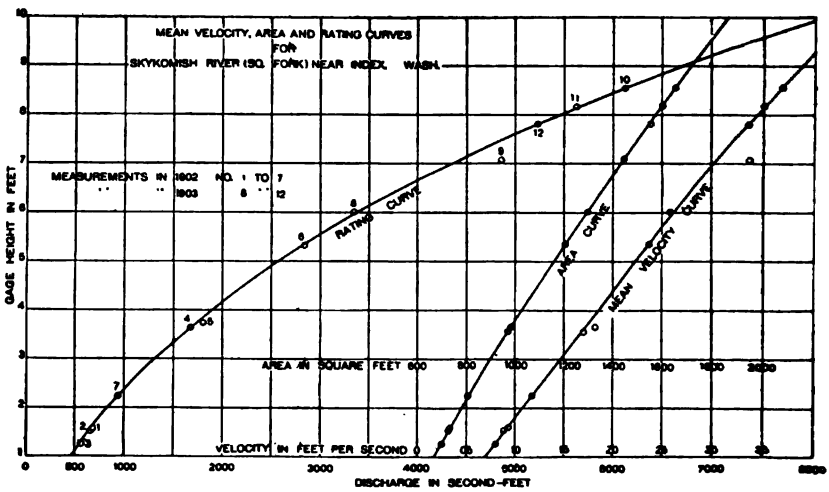


FIG. 2—Rating, area, and mean-velocity curves for South Fork of Skykomish River near Index, Wash.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remains constant. (2) The discharge will be the same whenever the stream is at a given stage, if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of the daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In the case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

California.—The hydrographic work in Susan and Owens rivers drainages in eastern California was under the direction of J. B. Lippincott, supervising engineer; W. B. Clapp, district hydrographer; assisted by R. J. Taylor, J. S. Evans, F. R. S. Buttemer, and J. Branham. The results of the data collected in Owens River Valley are contained in Water-Supply Paper No. 177, which contains the results of all the hydrographic data collected in the State of California during 1905.

The work in the Truckee, Carson, and Walker rivers drainages was under the direction of Henry Thurtell, State engineer of Nevada, assisted by W. A. Wolf.

Idaho.—The work in that portion of Idaho which lies in the Great Basin was under the direction of George L. Swendsen, district engineer, assisted by W. G. Swendsen, hydrographer.

Nevada.—The hydrographic work in this section has been carried on in cooperation with the State by Henry Thurtell, State engineer, assisted by W. A. Wolf. Acknowledgment is due to the Southern Pacific Company and also to the San Pedro, Los Angeles and Salt Lake Railroad Company for transportation furnished.

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GENERAL DESCRIPTION OF THE GREAT BASIN.

In the interior of the North American continent, west of the Rocky Mountains, is an immense area known as the Great Basin, the streams of which do not discharge to the ocean. The area is not one single drainage basin, but consists rather of a number of basins, some of which are connected and others closed; the outer rim of all, however, is at such an elevation that the region as a whole has no surface outlet.

In outline the Great Basin is rudely triangular. It is bordered on the west by the Sierra Nevada, on the north by the Columbia plateaus, on the east by the Rocky Mountains and the Colorado plateaus, and the southern extremity extends almost to the Gulf of California. This inclosed area is approximately 800 miles long from north to south, 500 miles broad at its widest part, and has been estimated to include 208,000 square miles. It comprises the western part of Utah, almost all of Nevada, and contiguous parts of Idaho, Oregon, and California.

Topographically this interior drainage area is characterized by isolated, narrow mountain ranges, trending north and south, which are seperated by broad valleys varying considerably in altitude. In the southern part the valleys are low, Death Valley being below sea level, while in the north the valleys have a general elevation of from 4,000 to 5,000 feet. The intervening highlands often rise several thousand feet above their bases, and some of the peaks of the bordering ranges attain elevations of 13,000 feet above sea level.

Upper branches of the intermontane valleys extend into the interior ranges as narrow drainage ways that are dry during most of the year; but the drainage from the high mountains on the east and west borders of the basin passes through deep canyons into the broad valleys, where the perennial streams maintain lakes. Among these are Great Salt, Utah, and Sevier lakes in the eastern part, and Pyramid, Winnemucca, Honey, Walker, Mono, and Owens lakes in the western part of the Great Basin. With the exception of Utah Lake, which discharges by Jordan River into Great Salt Lake, these lakes are saline in character, as a consequence of the concentration of salts due to evaporation. Bear Lake, in the mountains of the eastern border, and Lake Tahoe, in the Sierras, are large bodies of fresh water that drain, respectively, to Great Salt and Pyramid lakes. Shallow, temporary bodies of water accumulate in some of the broad intermontane val-

leys during the wet season, but completely evaporate during the summer, leaving muddy plains called playas.

Geologically the Great Basin is well known as the type region of the "Basin Range structure." Many of the isolated, narrow mountain ranges that trend north and south are steep on one side, exposing cross sections of the rocks, and sloping on the other, conforming with the dip of the strata. These ranges have been uplifted by movements of the earth's crust which have broken it into tilted blocks. The greatest displacements of the Great Basin are associated with the eastern and western borders, the Wasatch Mountains and the Sierra Nevada having been uplifted many thousand feet. The mountains of the Great Basin are commonly composed of Paleozoic strata, often modified by vulcanism, and the products of weathering and disintegration of these rocks have accumulated in the broad intervening valleys, which are strewn to great depths with unconsolidated débris.

The climate of the Great Basin is extremely arid, and except a few favored spots where irrigation is practiced, the region in general is a desert. Over the larger part of the area the annual precipitation is less than 10 inches, but it is greater on the bordering high lands, especially on the Sierra Nevada, where it is over 40 inches. Temperature varies widely, owing to the large extent of the area and to differences in elevation. Over most of the region the heat of the summer days is intense, but the diurnal variation is considerable. Evaporation is enormous. From the surface of water in the vicinity of Salt Lake City it amounts to about 60 inches in a year, and over the major part of the Great Basin it is much greater, amounting in places possibly to 150 inches.

An arid climate, however, has not always prevailed in this region. In late geologic time (early Quaternary) the bordering high mountains supported glaciers, and enormous lakes, the old shore lines of which are now plainly marked on the sides of many valleys, accumulated in the Great Basin. The two largest of these lakes have been named after early explorers. Lake Bonneville occupied a considerable part of western Utah, its shrunken remnants being represented by Sevier, Utah, and Great Salt lakes; and Lake Lahontan covered an immense area in western Nevada.

The chief rivers of the Great Basin rise in the mountains which form its eastern and western borders and receive their principal supply from melting snow. The nature of the stream discharge is characteristic; the maximum commonly occurs in late spring or early summer, after which the flow decreases, reaching a minimum during the winter months. After leaving the mountains the streams receive little or no increment; in the broad, waste-filled valleys evaporation and seepage cause diminution in size, and often they entirely cease to flow.

For convenience of treatment, the drainage of the Great Basin has been divided into four areas, viz, Wasatch Mountains, Humboldt Sink, Sierra Nevada, and minor Great Basin drainages. The data collected in these areas during 1905 are given in the following pages:

WASATCH MOUNTAINS DRAINAGE.

PRINCIPAL STREAMS.

The Wasatch Mountains drainage area includes the western half of Utah and small portions of Idaho and Wyoming. The headwaters of the various streams lie either in the Wasatch Mountains or in the plateaus to the south, and they drain either into Great Salt Lake or Sevier Lake. The following are the principal rivers of the area:

Bear and Weber rivers, discharging into Great Salt Lake.

City, Parleys, Emigration, Mill, and Big and Little Cottonwood creeks, tributary to Jordan River and thus to Great Salt Lake. These creeks have small watersheds, but in the mountain courses maintain perennial flows. On reaching the main valley they are extensively used for irrigation and the first three furnish the chief water supply for Salt Lake City.

American Fork and Hobble creeks, Spanish Fork, and Provo River, discharging into Utah Lake.

Sevier River, with its tributary, San Pitch River, draining into Sevier Lake.

BEAR RIVER BASIN.

DESCRIPTION OF BASIN.

Bear River rises on the northern slope of the Uinta Mountains, in the northeastern part of Utah, and after a circuitous course—in which it leaves Utah and enters Wyoming, reenters Utah, appears again in Wyoming, and makes a long detour in Idaho—it returns again to Utah and finally discharges its waters into Great Salt Lake. The maximum elevation of the upper rim of the basin is 13,000 feet.

In the upper part of its course, above the Dingle gaging station, the country is rough and broken, the rocks of the extreme headwater regions being principally sandstone and quartzite, covered with a thin layer of soil which supports scattered groves of fir and aspen. Farther down the prevailing formation is a compact limestone covered with a clayey soil, generally dry and with a rank growth of sagebrush. The tributary streams are numerous and well distributed, but they are generally short and confined to steep, narrow canyons. There are no marshes, extensive meadows, or forests, but a few small lakes lie near the head of the river. Numerous small springs and the melting snow which comprises the greater part of the precipitation are the chief sources of suppply. The annual high-water period occurs during May and June, and the stream is not subject to quick floods or freshets.

Just below Dingle the main stream passes through the north end of Bear Lake Valley in a well-defined channel with no overflow, and from this point to Preston it is confined largely to a steep, narrow canyon, with occasional small, narrow valleys containing irrigated farms. The tributaries in this portion of the basin are few, the principal ones being Mink and Cottonwood creeks. About 10 miles below Dingle the outlet to Bear Lake joins the river. This is a small, crooked, sluggish stream, that discharges but little water at any time, though it is the only visible outlet to Bear Lake, which has an area of about 144 square miles.

The total unappropriated flow between Dingle and Preston is used for irrigation. There is no storage on the main stream, but on Mink Creek a number of small storage reservoirs are contemplated or in process of construction, the water to be diverted for the irrigation of lands in the northwest end of Cache Valley.

Between Preston and Collinston the Bear is a sluggish stream, traversing the west side of Cache Valley in a well-defined channel, which during extreme floods overflows slightly and covers a very narrow strip immediately along the river. The principal tributary streams in this portion of the course are Cub Creek and Logan River. The former has its source in the Bear River Range, and drains a rough country composed of limestone with but little overlying soil. The creek is confined to a steep, narrow canyon until it reaches Cache Valley, where it flows sluggishly for about 15 miles through a winding, but well-defined, channel into Bear River. It discharges considerable water into the main stream during flood and winter seasons, but its entire summer flow is used for irrigation in the north end of Cache Valley. A gaging station was maintained during a part of 1900 and 1901 on Cub Creek about 4 miles northeast of Franklin, at the mouth of the canyon, but, owing to unfavorable conditions, it was discontinued.

Logan River enters the Bear about 7 miles above the gaging station at Collinston, a short distance above the point where it leaves Cache Valley and enters the canyon.

Practically the only inflow to the Bear in Cache Valley is from seepage and springs. The lower portions of the valley form an artesian basin containing numerous small, flowing wells. The water table lies very near the surface, and during the early spring the lower lands are largely swamp.

The Bear River Canal Company diverts the entire summer flow of the stream above Collinston onto agricultural lands lying on both sides of the river below Bear River Canyon. This system has a capacity of about 1,000 second-feet, and during the winter and flood seasons a part of the water is used to develop electric power at a point about one-fourth mile above the Collinston station, being returned to the river at Collinston. From 10 to 30 second-feet reach the stream through leaks and as seepage from the diversion canals.

Owing to the complete control of the stream by irrigation works, the discharge is liable to extreme variation at any period.

BEAR LAKE AT FISHHAVEN, IDAHO.

This station was established October 5, 1903. It is located at Fishhaven, Idaho, on the west shore of Bear Lake, about 4 miles north of the Idaho-Utah State line. It is on land used as a summer resort, owned by G. C. Gray, of Montpelier, Idaho, and is immediately south of the summer resort known as Nelsons Camp.

A plain staff gage, read when the surface of the lake is calm by John L. Nelson, is driven vertically into the bed of the lake 10 feet east of a crib where water from a spring rises to the surface. The gage is protected by 2 by 4 inch stakes driven on either side. The spring melts the ice before the regular breaking-up season, the consequence being that the shore at this point is comparatively free from ice, while only a few hundred feet away it is piled up in great, grinding masses. The gage is referred to bench marks as follows: (1) A wooden hub driven flush with the ground, 1 foot south of a 15-inch cottonwood tree, 1 foot east of a fence on the east side of the county road, 142 feet north of the gage, and about 18° to the west; elevation above zero of gage, 12.19 feet. (2) A shoulder cut on an above-ground root of a 20-inch cottonwood tree, 2 feet southeast of the southeast corner of the porch of a house on the summer-resort grounds; it bears 81° W., 93 feet south of the gage rod; elevation above zero of gage, 7.13 feet. By readings on the lake surface here and at the north end of the lake, October 5, 1903, the elevation of the zero of gage was found to be 12.26 feet by the datum used on canal surveys, etc., during 1903. This elevation is probably correct to within 0.05 foot. The elevation above sea level is approximately 6,000 feet.

An extreme high-water mark pointed out by the observer, who has lived here thirty-three years, indicates that twenty or thirty years ago the surface of the lake stood at approximately gage height 6.5 feet. A more definite mark shows a gage height of 6 feet as occurring twenty years ago

Daily gage height, in feet, of Bear Lake at Fishhaven, Idaho, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
2									2.7			
5	2.5							3.0				
6		2.55										
8				2.9			3.05			2.4		
10			2.7			3.15						1.85
11											2.05	
12								2.9				
14					3.15				2.6			
15		2.55										
16	2.5									2.3		
17			2.7	2.95								
18												1.8
19								2.8				
20						3.15	3.03				2.0	
22		2.6										
23					3.2							
24	2.5											
25			2.75	2.1								
26									2.5	2.2		
27												1.8
28		2.65										
29							3.03					
30				3.05		3.1						
31	2.5		2.8		3.25						1.9	

NOTE.—Lake frozen over from February 22 to March 17.

BEAR RIVER AT DINGLE, IDAHO.

This station was established May 9, 1903. It is located in a cut made by the Oregon Short Line Railroad Company one-fourth mile east of the Dingle railroad station and about 250 feet south of the track.

The channel is straight for about 400 feet above and below the station. Both banks are high, are not liable to overflow, and are barren except for small brush. The bed of the stream is of well-compacted small gravel and soil and seems to be permanent. The velocity is moderate at ordinary stages, and is well distributed. The stream freezes over late in November or early in December, and ordinarily the ice does not begin to break up until late in February. There is no anchor or needle ice at any stage. Winter records at this station are of special importance, as the object of the station is the collection of facts concerning the amount of water available for storage in Bear Lake.

Discharge measurements are made by means of a cable and car of the regular form, the length of the span being 151 feet. The cable is marked at 10-foot intervals with white paint. The initial point for soundings is the first mark from the north and is 8 feet from the north cable support.

The gage, which is read daily by M. K. Hopkins, was originally of the vertical type, but in December, 1905, it was replaced by a new inclined gage, consisting of a 6 by 6 inch fir, fastened to three vertical double posts well embedded in the bank. It is located 3 feet below the old gage and about 25 feet above the cable. The datum of the new gage was made to agree with that of the old one. The gage is referred to bench marks as follows: (1) A United States Geological Survey standard metallic post bearing N. 33° 15′ E., 37 feet from as north end of cable; elevation above zero of gage, 15.59 feet; elevation above mean sea level, determined from Oregon Short Line Railroad elevations, 6,000 feet. (2) Top of south cable post; elevation, 18.04 feet above zero of gage. (3) Top of 4-foot stick of timber planted 2.7 feet in the ground; elevation above zero of gage, 18.42 feet. During the winter of 1904–5 gage readings were taken once or twice each week, the surface of the water being read after the ice had been cut around the gage and the thickness of the ice in each case noted.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 135; 133, p 238.
Discharge: 100, p 135; 138, p 238.
Discharge, monthly: 100, p 137; 133, p 240.
Gage heights: 100, p 136; 133, p 239.
Rating table: 100, p 136; 133, p 240.

Discharge measurements of Bear River at Dingle, Idaho, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 13 [a]	C. Tanner	92	136	1.43	[b] 4.45	194
March 24	W. G. Swendsen	107	210	1.80	4.22	379
September 19	do	97	136	.98	3.48	133

[a] Stream frozen; ice 1 foot thick near the center and increasing gradually to 1.5 feet at either side. No anchor or slush ice.
[b] Surface of water in hole cut in ice.

Daily gage height, in feet, of Bear River at Dingle, Idaho, for 1905.

Day.	Jan.*	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.8	.....	.....	4.2	4.2	3.7	3.85	3.35	3.3	3.5	3.55	3.5*
2	4.7	.....	4.8	4.1	4.15	3.95	3.8	3.4	3.3	3.5	3.55	3.5
3	4.6	4.8	.....	4.1	4.2	4.0	3.75	3.35	3.3	3.5	3.55	3.5
4	4.6	4.8	4.7	4.1	4.2	3.95	3.75	3.4	3.3	3.5	3.6	3.55
5	4.4	4.8	.....	4.1	4.2	4.05	3.8	3.4	3.3	3.5	3.55	3.5
6	4.4	.....	4.45	4.05	4.15	4.2	3.8	3.35	3.4	3.5	3.55	3.5
7	4.5	.....	4.45	4.0	4.1	4.25	3.65	3.3	3.4	3.5	3.55	4.4
8	4.5	.....	.....	4.0	4.1	4.5	3.5	3.3	3.4	3.5	3.5	4.4
9	4.5	.....	4.4	4.1	4.1	4.65	3.4	3.3	3.4	3.5	3.55	4.5
10	4.5	.....	.....	4.1	4.1	4.6	3.45	3.3	3.4	3.5	3.55	4.25
11	4.6	4.6	4.4	4.1	4.05	4.6	3.5	3.3	3.4	3.5	3.55	.....
12	4.6	.....	4.4	4.1	4.05	4.7	3.5	3.3	3.35	.....	3.55	.....
13	.....	4.45	4.7	4.1	4.0	4.9	3.65	3.3	3.35	3.5	3.5	.....
14	4.6	4.45	4.4	4.1	4.0	5.0	3.7	3.3	3.35	3.5	3.55	4.35
15	.....	.....	4.4	4.15	4.0	4.8	3.7	3.3	3.35	3.5	3.55	.....
16	.....	.....	4.45	4.2	3.9	4.7	3.7	3.3	3.35	3.5	3.55	.....
17	4.7	.....	4.45	4.2	3.9	4.75	3.65	3.3	3.35	3.5	3.5	4.6
18	.....	4.45	4.4	4.2	4.0	4.9	3.6	3.3	3.35	3.5	.....	.....
19	.....	.....	4.4	4.2	3.9	5.05	3.6	3.3	3.45	3.5	3.55	.....
20	.....	.....	4.4	4.2	3.9	4.95	3.6	3.2	3.5	3.5	3.55	.....
21	4.7	.....	4.4	4.2	3.9	4.8	3.6	3.2	3.5	3.5	3.5	4.9
22	.....	4.7	4.3	4.2	3.9	4.65	3.55	3.2	3.5	3.5	3.55	.....
23	.....	.....	4.3	.....	3.95	4.35	3.5	3.2	3.5	3.5	3.55	.....
24	4.8	.....	4.2	4.2	3.95	4.2	3.5	3.2	3.5	3.5	3.55	.....
25	.....	4.7	.....	4.2	3.95	4.1	3.5	3.2	3.5	3.55	3.55	3.8
26	.....	.....	4.2	4.2	3.9	4.0	3.4	3.2	3.45	3.55	3.55	.....
27	.....	4.8	4.2	4.2	3.9	3.95	3.4	3.2	3.5	3.55	.....	.....
28	4.7	.....	4.2	4.2	3.8	4.0	3.35	3.3	3.45	3.55	3.5	3.8
29	.....	.....	4.2	4.2	3.8	3.95	3.3	3.3	3.5	3.6	3.3	.....
30	4.8	.....	4.2	4.1	3.8	3.9	3.4	3.3	3.5	3.55	3.2	.....
31	.....	.....	4.2	.....	3.75	.....	3.35	3.3	.....	3.55	.....	4.0

NOTE.—River frozen January 1 to about March 14 and December 7 to 31. During this period the readings were to the water surface in a hole cut in the ice.

The following thicknesses of ice were recorded:

	Thickness in feet.		Thickness in feet.
January 4	0.75	February 11	1.1
January 8	1.0	February 18	1.2
January 21	1.2	February 22	1.2
January 24	1.2	February 25	1.3
January 28	1.2	February 27	1.3
February 4	1.1	March 2	1.2
February 5	1.1	March 6	.7

March 11, ice nearly gone. March 18, no ice at gage.

Station rating table for Bear River at Dingle, Idaho, from March 11 to December 6, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	60	3.90	260	4.70	590	5.50	1,020
3.20	75	4.00	295	4.80	635	5.60	1,085
3.30	90	4.10	330	4.90	685	5.70	1,155
3.40	110	4.20	370	5.00	740	5.80	1,230
3.50	135	4.30	410	5.10	790	5.90	1,300
3.60	160	4.40	455	5.20	840	6.00	1,375
3.70	190	4.50	495	5.30	895	6.10	1,460
3.80	225	4.60	540	5.40	955		

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1903-1905. It is well defined between gage heights 3.5 feet and 7.4 feet. Above gage height 6.1 feet the rating curve is a tangent, the difference being 90 per tenth.

The above table is the same as that used for 1904.

Estimated monthly discharge of Bear River at Dingle, Idaho, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	310	180	259	15,920
February	310	195	259	14,380
March	590	180	365	22,440
April	370	295	348	20,710
May	370	208	294	18,080
June	765	190	467	27,790
July	242	90	157	9,654
August	110	75	89	5,472
September	135	90	113	6,724
October	160	135	138	8,485
November	160	75	141	8,390
December 1-6	147	135	137	1,630
The period				159,700

NOTE.—Discharge interpolated for days when the gage was not read.

Estimates for January, February, and March corrected for effect of ice. They are merely approximate.

BEAR RIVER NEAR PRESTON, IDAHO.

This station was established October 11, 1889. It is located about 6 miles from Preston, Idaho, 10 miles north of the Idaho-Utah boundary line and about 300 feet below the county road crossing at the old bridge of the Oregon Short Line Railroad. The data collected at this station are of extreme importance as showing the amount of water that passes from Idaho into Utah and will be of great value in the final adjudication of water rights on the stream.

The channel is straight for about 250 feet above and below the station. Both banks are barren and are sufficiently high to prevent overflow. The bed of the stream is of gravel and clay and is permanent. A light growth of moss near the north side of the gaging section interferes slightly with summer records; otherwise the conditions are good. The stream is ice covered from about the end of December to the middle of February. There is no needle ice and but little fluctuation.

Discharge measurements are made by means of a cable and car, rebuilt in 1904. The cable has a span of about 250 feet and is marked at 10-foot intervals with red paint. The initial point for soundings is the north post supporting the cable.

The gage, which is read daily by Mrs. Hannah Nelson, was originally of the vertical type and consisted of a board nailed to a pile of the highway bridge. This was replaced August 4, 1899, by a wire gage, which proved unsatisfactory, and October 31, 1903, a new temporary gage was again attached to the bridge pile. In December, 1904, a new inclined gage was established at a point about 50 feet below the bridge. It consists of a piece of 8 by 8 inch fir, supported by three vertical double posts. The bench mark is a United States Geological Survey standard metallic post, set flush with the surface of the ground at a point about 8 feet upstream from the south post supporting the cable; elevation above zero of gage, 7.428 feet. All readings have been reduced as nearly as possible to the same datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, pp 118-119; 18, iv, p 313; Bull 131, p 53; 140, pp 225; WS 16, p 157; 28, p 146; 38, pp 332-333; 51, p 409; 66, p 117; 85, p 82; 100, pp 133-134; 133, p 241.

Discharge: Ann 18, iv, p 314; Bull 131, pp 53, 92; 140, p 226; WS 16, p 157; 28, p 153; 35, pp 18-19; 38, p 333; 51, p 409; 66, p 117; 85, p 83; 100, p 134; 133, p 241.

Discharge, monthly: Ann 11, ii, p 102; 12, ii, pp 352, 360; 13, iii, p 96; 14, i, p 119; 18, iv, p 315; 19, iv, p 432; 20, iv, p 459; 21, iv, p 394; 22, iv, p 407; Bull 140, p 227; WS 75, p 191; 85, p 84; 133, p 243.

Discharge, yearly: Ann 11, ii, p 69; 13, p 99; 20, iv, p 60.

Gage heights: Bull 131, pp 54-55; 140, p 226; WS 11, p 76; 16, p 157; 28, p 149; 38, p 334; 51, p 410; 66, p 117; 85, p 83; 100, p 134; 133, p 242.

Hydrographs: Ann 12, ii, p 330; 14, ii, p 118; 18, iv, p 316; 19, iv, p 433; 20, iv, p 460; 22, iv, p 407; 75 p 191.

Rating tables: Ann 18, iv, p 314; 19, iv, p 432; Bull 131, p 54; 140, p 226; WS 28, p 154; 39, p 452; 52, p 521; 66, p 176; 85, p 84; 133, p 242.

Discharge measurements of Bear River near Preston, Idaho, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 25	W. G. Swendsen	188	348	1.78	1.60	617
February 17[a]	C. Tanner	197	524	1.46	2.80	766
March 23	W. G. Swendsen	192	470	2.26	2.15	1,059
March 23	do	192	470	2.27	2.15	1,067
May 3	do	196	513	2.64	2.45	1,354
June 7	do	187	358	1.60	1.45	574
July 11	do	152	203	.89	.60	182
August 23	W. D. Beers	145	216	.82	.60	177
September 16	W. G. Swendsen	171	239	1.22	.80	291
October 30	do	186	340	1.56	1.43	528

[a] Back water caused by a large quantity of floating ice piled up near the gaging station. This rendered the velocity zero for 60 feet in the middle of the stream. There was a small amount of ice on the edges of the stream at the gaging station, but none near the gage.

Daily gage height, in feet, of Bear River near Preston, Idaho, for 1905:

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	1.5	1.5	1.88	2.15	1.7	.....	0.5	0.7	1.0	1.04	1.3
2	2.6	1.5	1.52	1.8	2.33	1.7	.....	.5	.7	1.0	1.04	1.25
3	2.6	1.6	1.55	1.8	2.42	1.62	.....	.5	.7	1.07	1.04	1.25
4	2.6	1.6	1.6	1.8	2.38	1.6	.....	.5	.7	1.18	1.04	1.25
5	2.5	.....	1.6	1.8	2.3	1.63	0.6	.62	.7	1.32	1.04	1.25
6	2.5	1.6	1.68	1.8	2.23	1.53	.62	.5	.7	1.3	1.04	1.2
7	2.45	1.6	1.68	1.8	2.1	1.43	.7	.5	.72	1.3	1.04	1.37
8	2.4	1.6	1.72	1.8	2.1	1.47	.68	.5	.7	1.3	1.04	1.3
9	2.4	1.6	1.78	1.8	2.1	1.4	.63	.5	.7	1.3	1.04	1.4
10	2.4	1.8	1.78	1.8	2.1	1.43	.6	.5	.7	1.3	1.04	1.4
11	2.4	1.9	1.85	1.8	2.05	1.53	.6	.5	.7	1.3	1.04	1.5
12	2.4	.....	1.92	1.8	2.05	1.65	.6	.5	.72	1.3	1.04	1.7
13	2.4	.....	2.0	1.8	2.0	1.67	.6	.5	.8	1.35	1.04	2.0
14	2.4	.....	2.07	1.87	1.95	1.85	.6	.5	.8	1.32	1.04	2.6
15	.....	2.8	2.15	1.9	1.95	1.68	.6	.5	.8	1.22	1.04	.....
16	3.5	2.72	2.2	1.9	2.0	1.6	.6	.5	.8	1.05	1.04	.....
17	3.5	2.7	2.15	1.97	2.05	1.72	.6	.5	.8	1.05	1.35	.....
18	3.5	2.55	2.25	2.02	2.15	1.87	.6	.5	.77	1.04	1.3	2.65
19	1.5	2.57	2.3	2.08	2.15	1.9	.6	.5	.7	1.04	1.3	.....
20	1.5	2.48	2.27	2.0	2.15	1.9	.6	.5	.8	1.04	1.35	.....
21	1.5	1.5	2.23	1.95	2.1	1.65	.8	.5	.8	1.04	1.32	.....
22	1.5	1.5	2.2	1.97	2.07	1.5	.8	.6	.8	1.04	1.3	.....
23	1.6	1.5	2.12	2.0	2.0	1.42	.8	.75	.8	1.04	1.3	2.45
24	1.6	1.5	2.1	2.0	1.95	1.32	.8	.63	.8	1.04	1.27	.....
25	.....	1.58	2.05	2.07	1.9	1.25	.75	.7	1.0	1.04	1.25	.....
26	1.55	1.6	2.07	2.1	1.9	1.2	.7	.67	.95	1.45	1.25	.....
27	1.5	1.55	2.1	2.05	1.9	1.0	.65	.65	.9	1.45	1.25	.....
28	1.5	1.52	2.0	2.05	1.9	.....	.6	.7	1.0	1.45	1.25	.....
29	1.5	.....	2.0	2.05	1.87	.....	.6	.7	1.0	1.45	1.27	.....
30	1.5	.....	2.0	2.05	1.8	.....	.55	.7	1.0	1.41	1.3	.....
31	1.5	.....	1.95	.....	1.72	.....	.52	.7	.....	1.41	.....	.....

NOTE.—River frozen January 1-18 and February 10-20. Ice conditions December 7-31.

Station rating table for Bear River near Preston, Idaho, from January 1 to December 31, 1905.

Gage height.	Discharge	Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	158	1.10	371	1.60	642	2.10	1,020
.60	186	1.20	418	1.70	708	2.20	1,110
.70	217	1.30	468	1.80	779	2.30	1,205
.80	251	1.40	522	1.90	855	2.40	1,300
.90	288	1.50	580	2.00	935	2.50	1,400
1.00	328						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904-5. It is well defined throughout.

Estimated monthly discharge of Bear River near Preston, Idaho, for 1905.

[Drainage area, 4,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 19-31	642	580	595	15,340	0.132	0.064
February 1-9; 21-28	642	580	615	20,740	.137	.087
March	1,205	580	907	55,770	.202	.233
April	1,020	779	871	51,830	.194	.216
May	1,320	722	991	60,930	.220	.254
June	855	328	599	35,640	.133	.148
July	251	164	201	12,360	.045	.052
August	234	158	176	10,820	.039	.045
September	328	217	250	14,880	.056	.062
October	551	328	429	26,380	.095	.110
November	495	346	401	23,860	.089	.099
December 1-6	468	418	443	5,272	.098	.022
The period				333,800		

NOTE.—Discharge interpolated on days when gage was not read.

BEAR RIVER NEAR COLLINSTON, UTAH.

This station was established July 1, 1889. It is located 6 miles from Collinston station on the Oregon Short Line Railroad, about one-fourth mile below the electric-power plant in Bear River Canyon. It is at the lower end of the canyon separating Cache and Great Salt Lake valleys, at a point below all diversion from the stream. It shows the amount of unappropriated water that is discharged as waste into Great Salt Lake.

The stream at this point is wide and shallow. Both banks are sufficiently high to prevent overflow; the west bank slopes gradually, while the east is abrupt. The bed is composed of bowlders and clay and is somewhat rough, but apparently permanent. A deposit of material which was washed into the stream by the water from a spillway at the power plant during 1903 changed the original condition considerably during 1903 and 1904. The cross section was rechecked, however, in March, 1905, and found to agree very closely with the original standard cross section, the new material having been washed out. The velocity ranges from 2 to 4 feet per second. There is a free flow except at a small hole near the east bank. The discharge ranges from 7,000 feet during flood season to nothing during the summer, when the entire flow is diverted for irrigation above the station. The stream probably never freezes entirely over, but ice forms along the edges to quite an extent during December and January.

Discharge measurements were originally made from a small boat attached by means of a chain and pulley to a cable stretched across the stream. During 1904 discharge measurements were made from a bridge recently built across the stream at the power house, but owing to poor conditions at this point a cable and car were established at the old section in January, 1905. The total length of the span is 301 feet. The cable is marked at 20-foot intervals with paint, beginning at the west post, which is the initial point for soundings.

The gage, which is read daily by D. A. Cannon, a watchman along the Bear River canals, consisted originally of a vertical iron bar driven into the river bed and supported at the top by a horizontal bar fastened to posts on the bank. It was replaced in February, 1905, by an inclined gage. This is a 6 by 6 inch fir, fastened by means of iron straps to three posts firmly embedded in the bank, and graduated to read vertically. It is located at the same point as the old vertical gage. The low-water gage is an iron peg driven into the bed of the stream about 50 feet from the west bank. It has the same datum as the regular gage.

The gage is referred to bench marks as follows: (1) A metallic post, 3 inches in diameter and 4 feet long, set in the ground at a point 30 feet S. 74° W. from the west post supporting the cable; elevation, 9.59 feet above zero of gage, and so stamped on the top; (2) a nail in an oak post 20 feet west of the gage and 20 feet north of the cable; elevation above gage datum, 7.35 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water Supply Paper):

Description: Ann 18, iv, p 319; Bull 131, pp 55-56; 140, p 227; WS 16, p 159; 28, p 146; 38, pp 335-336; 51, p 413; 66, p 120, 85, p 80; 100, p 131; 133, p 433.

Discharge: Ann 18, iv, p 319; Bull 131; pp 90, 92; 140, p 228; WS 16, p 159; 28, p 153; 35, pp 18-19; 38, p 336; 51, p 413; 66, p 120; 85, p 80; 100, p 131; 133, p 244.

Discharge, monthly: Ann 11, ii, p 103; 12, ii, pp 352, 360; 13, iii, p 96; 14, ii, pp 120-121; 18, iv, p 320, 19, iv, p 435; 20, iv, pp 458-460; 21, iv, p 395; 22, iv, p 410; Bull 140, p 229; WS 75, p 193; 85, p 82; 100, p 133; 133, p 245.

Discharge, yearly: Ann 11, ii, p 69; 13, iii, p 99; 20, iv, p 60.

Gage heights: Bull 131, pp 56-57; 140, p 229; WS 11, p 77; 16, p 159; 28, p 150; 38, p 336; 51, p 414; 66, p 121; 85, p 81; 100, p 132; 133, p 244.

Hydrographs: Ann 12, ii, p 332; 14, ii, p 121; 18, iv, p 320; 19, iv, p 435; 20, iv, p 461; 21, iv, p 395; 22 iv, p 411.

Rainfall and run-off relation: Ann 20, iv, p 459.

Rating tables: Ann 18, iv, p 320; 19, iv, p 434; Bull 140, p 228; WS 28, p 154; 39, p 453; 52, p 521; 66, p 176; 85, p 81; 100, p 132; 133, p 245.

Discharge measurements of Bear River near Collinston, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet*	*Second-feet.*
February 10	C. Tanner	270	486	2.46	1.75	1,195
March 29	W. G. Swendsen	275	711	2.73	2.50	1,943
March 29	do	275	711	2.78	2.50	1,976
May 17	do	275	684	2.79	2.45	1,910
September 7[a]	A. B. Larson	19	19	1.64	.37	31
October 31	W. G. Swendsen	268	466	2.32	1.60	1,039

[a] 350 feet below regular station.

Daily gage height, in feet, of Bear River near Collinston, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.9	1.95	2.35	2.6	2.25	−0.1	−0.5	−0.5	1.2	1.55	1.4
2	1.8	1.95	1.95	2.3	2.8	2.2	− .1	− .5	− .5	1.2	1.55	1.45
3	1.75	2.0	2.0	2.2	3.1	2.1	− .15	− .5	− .5	1.1	1.55	1.45
4	1.75	2.0	2.0	2.15	3.15	2.1	.....	− .55	− .5	1.1	1.55	1.45
5	1.8	2.0	2.0	2.1	3.0	2.05	− .2	− .55	− .5	1.1	1.55	1.5
6	1.9	2.0	1.95	2.1	2.9	1.95	− .2	− .55	− .5	1.1	1.55	1.45
7	1.8	1.9	1.9	2.1	2.75	1.8	− .25	− .55	.....	1.1	1.6	1.4
8	1.6	1.85	1.95	2.15	2.65	1.6	− .25	− .55	− .4	1.15	1.6	1.3
9	1.75	1.8	1.95	2.2	2.6	1.4	− .3	− .55	− .4	1.15	1.6	1.2
10	1.9	1.75	1.9	2.2	2.6	1.35	− .3	− .55	− .4	1.2	1.6	1.1
11	1.7	1.7	1.9	2.3	2.6	1.3	− .4	− .55	− .4	1.2	1.6	1.0
12	1.7	1.5	1.95	2.3	2.6	1.3	− .4	− .55	− .35	1.2	1.6	1.0
13	1.8	1.3	2.0	2.25	2.6	1.35	− .45	− .5	− .3	1.2	1.6	1.05
14	1.6	1.4	2.1	2.2	2.5	1.4	− .45	− .5	− .3	1.25	1.55	1.05
15	1.6	1.6	2.1	2.3	2.4	1.4	− .45	− .5	+ .3	1.3	1.86	1.1
16	1.65	1.7	2.1	2.3	2.4	1.35	− .5	− .5	.3	1.3	1.55	1.1
17	1.7	1.7	2.1	2.3	2.4	1.3	− .5	− .5	.3	1.3	1.55	1.15
18	1.75	1.7	2.15	2.3	2.5	1.4	− .5	− .55	.3	1.35	1.55	1.15
19	1.75	1.7	2.25	2.4	2.8	1.4	− .5	− .55	.4	1.4	1.5	1.2
20	1.75	1.65	2.5	2.6	2.95	1.45	− .5	− .55	.4	1.45	1.5	1.25
21	1.7	1.65	2.4	2.6	3.0	1.45	− .5	− .55	.4	1.45	1.5	1.25
22	1.75	1.7	2.35	2.55	3.0	1.4	− .5	− .55	.4	1.4	1.45	1.2
23	1.8	1.7	2.35	2.55	2.9	1.35	− .45	− .55	.4	1.45	1.45	1.2
24	1.8	1.8	2.4	2.5	2.85	1.1	− .45	− .5	.35	1.5	1.45	1.25
25	1.85	1.9	2.4	2.45	2.8	.6	− .45	− .5	.3	1.5	1.45	.....
26	1.85	1.9	2.4	2.5	.....	.6	− .45	− .45	.3	1.5	1.45	1.3
27	1.85	1.9	2.5	2.55	.....	.55	− .45	− .45	.35	1.5	1.45	1.35
28	1.85	1.95	2.5	2.6	2.5	.55	− .5	− .5	.7	1.5	1.45	1.4
29	1.9	.....	2.5	2.6	2.55	.55	− .5	− .5	.65	1.5	1.5	1.45
30	1.95	.....	2.4	2.6	2.55	.5	− .5	− .5	.7	1.5	1.5	1.4
31	2.0	.....	2.4	.....	2.4	.....	− .5	− .5	.....	1.6	.....	1.35

Station rating table for Bear River near Collinston, Utah, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second feet.*	*Feet.*	*Second feet.*	*Feet.*	*Second feet.*	*Feet.*	*Second feet.*
−0.55	10	0.40	266	1.40	868	2.40	1,850
−0.50	15	.50	310	1.50	950	2.50	1,960
−0.40	29	.60	356	1.60	1,035	2.60	2,075
−0.30	47	.70	406	1.70	1,125	2.70	2,190
−0.20	68	.80	460	1.80	1,220	2.80	2,310
−0.10	92	.90	518	1.90	1,320	2.90	2,435
.00	120	1.00	580	2.00	1,420	3.00	2,560
.10	152	1.10	646	2.10	1,525	3.10	2,690
.20	187	1.20	716	2.20	1,630	3.20	2,830
.30	225	1.30	790	2.30	1,740		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–05. It is well defined between gage heights 1.3 feet and 2.5 feet.

Estimated monthly discharge of Bear River near Collinston, Utah, for 1905.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,420	1,035	1,199	73,720	0.200	0.231
February	1,420	790	1,199	66,590	.200	.208
March	1,960	1,320	1,605	98,690	.268	.309
April	2,075	1,525	1,800	107,100	.300	.335
May	2,760	1,850	2,201	135,300	.367	.423
June	1,685	310	895	53,260	.149	.166
July	120	15	36.4	2,238	.0061	.0070
August	22	10	13.0	779	.0022	.0025
September	406	15	158	9,402	.026	.029
October	1,035	646	806	49,560	.134	.154
November	1,035	909	976	58,080	.163	.182
December	950	580	767	47,160	.128	.148
The year	2,760	10	971	701,900	.160	2.17

NOTE.—Discharge interpolated on days when gage was not read. Discharge applied for open channel during winter months.

LOGAN RIVER NEAR LOGAN, UTAH.

Logan River rises on the west slope of the Bear River Range, flows southwest, then northwest, and unites with Bear River near Benson, Utah. The entire basin is rough and rugged, the elevations ranging from 4,500 to 9,000 feet and the stream being confined largely to a steep and rough channel in a comparatively narrow canyon. The principal formation is a compact limestone, with little or no soil except near the summit of the range, where a thin layer supports quite extensive groves of fir and aspen. The lower reaches of the stream are practically barren of timber, except for a few scattered pine and mahogany trees and a rather thick growth of underbrush. A large amount of timber has been cut out and the area has been overgrazed by sheep and cattle. There are no flood basins or marshes in the region. Probably three-fourths of the precipitation in the basin is snow, the melting of which forms the chief source of supply for the spring and early summer flow; the late summer and winter flow is derived chiefly from springs, which are well distributed over the basin. In its upper course the stream has numerous small tributaries, all short and swift. Temple Fork and South Fork, which enter the river about 10 and 15 miles, respectively, above the gaging station, are perennial streams and furnish from one-third to one-fourth of the total flow. Blacksmith Fork comes in below the gaging station. There is no storage on the stream at present. The entire flow, after being utilized to furnish power at two electric plants near the mouth of the canyon, is used for irrigation.

A gaging station was established June 1, 1896, about 2 miles east of the city of Logan, near the mouth of the canyon. It was discontinued July 18, 1903, and reestablished April 13, 1904, at a point along the canyon road about 50 feet below the highway bridge, at the mouth of the canyon, 800 feet below the Hercules power house and about 1,000 feet above the old gaging station.

Th channel is straight for about 150 feet above and 75 feet below the gaging section. The banks are of rock and soil, permanent, and are sufficiently high to prevent overflow. The bed of the stream was originally of bowlders and gravel, well cemented together, very rough, and of such shape that the stream was not well distributed. When the station was reestablished the channel was improved by removing large bowlders and sufficient of the finer material to distribute the flow and render the bed comparatively smooth. During the

spring flood of 1904 a deposit of bowlders and gravel was made at the section, reducing it to about the original conditions, but leaving a loose and probably shifting bed. There is but one channel at all stages. Discharge ranges from about 150 to 1,000 second-feet, with a velocity of from 3 to 7 feet per second. The depth is 1.5 to 3.5 feet. There are no dams or riffles and the grade of the stream is about uniform. Winter flow is affected but little by ice, as the stream never freezes over.

Discharge measurements are made by means of a cable and car of the regular form. The cable is marked at 4-foot intervals with red paint. A guy line is stretched about 25 feet above the cable, for use during high water. The initial point for soundings is a 4 by 4 inch post, set in the west bank and projecting about 4 feet above the ground.

Observations are taken by the Telluride Power Company, under the direction of E. P. Bacon, manager. The gage is of the vertical type, consisting of a 2 by 2½ inch steel rod, with the upstream side drawn to an edge. It is driven into the bed of the stream and is supported at the top by a horizontal 4 by 4 inch fir buried in the bank and fastened to a vertical post near the water edge. The bench mark is a United States Geological Survey standard metallic plug, cemented in a limestone ledge 250 feet N. about 30° W. of the cable. on a prominent point near the north side of a road leading to the power house; elevation, 24.85 feet above zero of gage; elevation above mean sea level, as determined from Oregon Short Line Railroad elevations, 4,502 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 316-317; 19, iv, p 433; 20, iv, p 462; 21, iv, p 397; WS 16, p 158; 28, p 146; 38, p 334; 51, p 411; 66, p 118; 85, pp 86-87; 100, p 137; 133, p 246.
Discharge: Ann 18, iv, p 317; WS 16, p 158; 28, p 153; 38, p 335; 51, p 411; 66, p 118; 85, p 87; 100, p 137; 133, p 246.
Discharge, monthly: Ann 18, iv, p 318; 19, iv, p 434; 20, iv, p 462; 21, iv, p 397; 22, iv, p 408; WS 75, p 192; 133, p 248.
Discharge, yearly: Ann 20, iv, p 60.
Gage heights: WS 11, p 77; 16, p 158; 28, p 150; 38, p 335; 51, p 412; 66, p 119; 100, p 138; 133, pp 247, 248.
Hydrographs: Ann 19, iv, p 434; 20, iv, p 463; 22, iv, p 409.
Rating tables: Ann 18, iv, p 318; 19, iv, p 433; WS 28, p 154; 39, p 453; 52, p 521; 66, p 176; 133, p 247.

Discharge measurements of Logan River near Logan, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 22	W. G. Swendsen	51	49	3.16	4.40	155
February 21	do	50	49	3.26	4.45	160
March 21	do	51	52	2.57	4.40	134
April 17	do	51	58	3.02	4.50	175
June 5	do	57	109	5.86	5.61	637
August 21	W. D. Beers	52	56	2.79	4.55	155
August 24 [a]	do	39	59	2.53	4.48	149
September 14	W. G. Swendsen	51	50	3.20	4.52	161
October 29	do	51	43	2.89	4.40	124
November 26	do	51	42	3.02	4.37	126

[a] Measured 300 feet below station.

Daily gage height, in feet, of Logan River near Logan, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45	4.48	4.4	4.43	4.9	5.5	5.1	4.59	4.5	4.43	4.4	4.33
2	4.4	4.48	4.38	4.41	4.95	5.5	5.05	4.6	4.5	4.43	4.4	4.31
3	4.4	4.53	4.38	4.41	4.9	5.55	5.05	4.57	4.5	4.43	4.4	4.32
4	4.4	.....	4.4	4.41	4.85	5.55	5.05	4.57	4.5	4.4	4.4	4.31
5	4.4	4.5	4.4	4.41	4.75	5.57	5.0	4.57	4.52	4.4	4.4	4.25
6	4.4	4.4	4.4	4.4	4.7	5.58	4.95	4.57	4.52	4.4	4.4	4.25
7	4.4	4.4	4.4	4.45	4.75	5.45	4.9	4.57	4.53	4.4	4.4	4.25
8	4.4	4.4	4.4	4.45	4.8	5.5	4.85	4.57	4.5	4.42	4.4	4.25
9	4.4	4.4	4.42	4.48	4.85	5.5	4.8	4.57	4.48	4.45	4.4	4.25
10	4.4	4.4	4.42	4.46	4.75	5.5	4.75	4.56	4.48	4.45	4.4	4.27
11	4.4	4.4	4.42	4.5	4.8	5.5	4.7	4.56	4.48	4.45	4.4	4.33
12	4.35	4.25	.....	4.47	4.8	5.5	4.7	4.56	4.48	4.43	4.4	4.33
13	4.35	4.28	4.42	4.46	4.8	5.45	4.67	4.56	4.47	4.43	4.4	4.36
14	4.45	4.3	4.42	4.5	4.85	5.45	4.65	4.56	4.47	4.43	4.38	4.32
15	4.43	4.35	4.42	4.45	4.75	5.4	4.65	4.55	4.47	4.43	4.38	4.35
16	4.44	4.38	4.48	4.49	4.85	5.4	4.65	4.55	4.5	4.43	4.38	4.38
17	4.43	4.35	4.48	4.47	4.93	5.35	4.65	4.54	4.45	4.43	4.38	4.3
18	4.43	4.3	4.47	4.48	5.3	5.2	4.65	4.54	4.45	4.45	4.35	4.35
19	4.43	4.35	4.45	4.5	5.3	5.2	4.65	4.55	4.47	4.45	4.35	4.38
20	4.43	4.3	4.47	4.5	5.3	5.1	4.65	4.54	4.47	4.45	4.35	4.35
21	4.43	4.3	4.41	4.55	5.3	5.1	4.65	4.5	4.46	4.43	4.35	4.38
22	4.45	.....	4.45	4.55	5.25	5.07	4.65	4.54	4.45	4.43	4.33	4.38
23	4.45	4.38	4.4	4.65	5.25	5.1	4.65	4.5	4.45	4.42	4.35	4.33
24	4.47	4.4	4.45	4.65	5.2	5.1	4.65	4.48	4.45	4.42	4.35	4.35
25	4.45	4.38	4.43	4.65	5.25	5.1	4.6	4.5	4.48	4.42	4.35	4.35
26	4.45	4.3	.....	4.7	5.3	5.1	4.6	4.5	4.49	4.4	4.32	4.4
27	4.43	4.38	4.42	4.8	5.3	5.1	4.6	4.48	4.47	4.4	4.29	4.38
28	4.43	4.38	4.45	4.8	5.35	5.1	4.6	4.5	4.47	4.4	4.4	4.38
29	4.43	.....	4.45	4.75	5.3	5.1	4.6	4.5	4.47	4.4	4.38	4.38
30	4.43	.....	4.45	4.8	5.3	5.1	4.6	4.45	4.45	4.4	4.3	4.35
31	4.43	.....	4.45	.....	5.35	.....	4.6	4.5	.....	4.4	.....	4.38

NOTE.—Stream does not freeze at this point during winter months in sufficient amount to materially affect the rating.

Station rating table for Logan River near Logan, Utah, from April 25, 1904, to December 31, 1905.

Gage height	Discharge	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.30	109	5.00	350	5.70	675	6.40	1,052
4.40	136	5.10	394	5.80	726	6.50	1,108
4.50	164	5.20	438	5.90	779	6.60	1,164
4.60	195	5.30	483	6.00	833	6.70	1,222
4.70	230	5.40	529	6.10	887	6.80	1,280
4.80	268	5.50	577	6.20	941	6.90	1,338
4.90	308	5.60	625	6.30	996		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 21 discharge measurements made during 1904–1905. It is fairly well defined between gage heights 4.4 feet and 6.25 feet.

Estimated monthly discharge of Logan River near Logan, Utah, for 1905.

[Drainage area, 218 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	155	122	142	8,731	0.651	0.750
February	173	96	131	7,275	.601	.626
March	157	131	144	8,854	.661	.762
April	268	139	177	10,530	.812	.906
May	506	230	368	22,630	1.69	1.95
June	615	382	496	29,510	2.28	2.54
July	394	195	248	15,250	1.14	1.31
August	195	150	176	10,820	.807	.930
September	173	150	158	9,402	.725	.809
October	150	136	143	8,793	.656	.756
November	136	106	129	7,676	.592	.660
December	136	96	118	7,256	.541	.624
The year	615	96	202	146,700	.930	12.62

NOTE.—Discharge interpolated on days when gage was not read.

BLACKSMITH FORK NEAR HYRUM, UTAH.

This stream rises on the western slope of the Bear River Range and flows southwest and then northwest into Logan River. The drainage basin of the tributary is in every way similar to that of the main stream. Only the flood and winter discharge, however, reaches the Logan, the entire spring and summer flow being used for irrigation on the tillable lands below the gaging station.

The gaging station was established July 19, 1900, near the tollgate in the mouth of the canyon near Hyrum, Utah, which is the nearest post-office. The station was discontinued December 31, 1902, and reestablished May 16, 1904, about 1,000 feet downstream from the tollgate and 800 feet above the Hyrum city electric-power plant. A station is also maintained at the power-plant race.

The channel is straight for 200 feet above and 50 feet below the station. The right bank for 20 feet back is a low, wooded flat, subject to overflow during extreme high water; beyond this point the bank is high and barren. The left bank is wooded and high and does not overflow. The bed of the stream is composed of bowlders and gravel and is somewhat rough, but apparently permanent, though a slight change seems to have occurred during December, 1904. During flood stages the velocity is high, ranging from 4 to 6 feet per second; under normal conditions it is 2 to 3 feet per second. The discharge varies from about 80 to 1,000 second-feet. Ice does not form in sufficient quantity to interfere with the results at any stage.

Discharge measurements are made by means of a cable and car of regular form. The cable is marked at 4-foot intervals with red paint. A guy line for use during high water is stretched across the stream about 30 feet above the cable. The initial point for soundings is the south post supporting the cable.

The gage, which is observed daily by Uriah Benson, a farmer living at the tollgate, is of the vertical type, and consists of a 2 by 2½ inch iron bar with the upstream side drawn to an edge, driven into the bed of the stream and supported by a horizontal piece buried in the bank. The gage is referred to bench marks as follows: (1) A United States Geological Survey standard metallic plug, set in a solid limestone ledge about 40 feet east of the north post supporting the cable; elevation above zero of gage, 17.875 feet. (2) Top of the eyebolt of the north anchor of the cable; elevation above zero of gage, 9.578 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 51, p 412; 66, p 119; 85, p 84, 133; p 249.
Discharge: WS 51, p 412; 66, p 119; 85, p 85; 133, p 249.
Discharge, monthly: Ann 22, iv, p 409; WS 75, p 192; 85, p 86; 133, p 251.
Gage heights: WS 51, p 413; 66, p 120; 85, p 85; 133, p 250.
Hydrograph: Ann 22, iv, p 410.
Rating tables: WS 52, p 521; 66, p 176; 85, p 86; 133, p 250.

Discharge measurements of Blacksmith Fork near Hyrum, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 23	W. G. Swendsen	38	35	2.26	3.50	78
February 22	do	38	24	2.32	3.50	80
April 16	do	39	44	2.72	3.70	119
May 4	do	41	58	3.18	3.98	186
July 9	do	39	41	2.29	3.00	95
August 22	W. D. Beers	37	30	1.91	3.60	77
October 28	W. G. Swendsen	30	23	1.23	3.30	28
November 27	do	30	23	1.33	3.31	31

Daily gage height, in feet, of Blacksmith Fork near Hyrum, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.5	3.5	3.6	4.0	4.1	3.6	3.6	4.8	3.6	3.3	3.3
2	3.5	3.5	3.5	3.6	4.0	4.1	3.6	3.6	4.8	3.6	3.3	3.3
3	3.5	3.5	3.5	3.6	4.0	4.1	3.6	3.6	4.8	3.6	3.3	3.3
4	3.5	3.5	3.5	3.6	4.0	4.1	3.6	3.6	4.8	3.6	3.3	3.3
5	3.5	3.5	3.5	3.6	4.0	4.1	3.6	3.6	4.8	3.6	3.3	3.3
6	3.4	3.5	3.5	3.6	3.9	3.9	3.6	3.6	4.8	3.6	3.3	3.3
7	3.4	3.5	3.5	3.6	3.9	3.9	3.6	3.6	4.8	3.6	3.3	3.3
8	3.5	3.5	3.5	3.7	3.9	3.9	3.6	3.6	4.8	3.6	3.3	3.3
9	3.5	3.4	3.5	3.7	3.9	3.9	3.6	3.6	4.8	3.6	3.3	3.3
10	3.5	3.4	3.5	3.6	3.9	3.8	3.6	3.6	4.8	3.6	3.3	3.3
11	3.5	3.4	3.5	3.6	3.9	3.8	3.6	3.6	4.8	3.6	3.3	3.2
12	3.5	3.4	3.5	3.6	3.9	3.8	3.6	3.6	4.8	3.6	3.3	3.2
13	3.5	3.4	3.5	3.7	3.9	3.8	3.6	3.6	4.8	3.6	3.3	3.2
14	3.5	3.5	3.5	3.7	3.9	3.8	3.6	3.6	4.8	3.6	3.3	3.2
15	3.5	3.5	3.5	3.7	3.9	3.8	3.6	3.6	3.6	3.6	3.3	3.2
16	3.5	3.5	3.5	3.7	3.9	3.8	3.6	3.6	3.6	3.6	3.3	3.3
17	3.5	3.5	3.5	3.7	3.9	3.8	3.6	3.6	3.6	3.6	3.3	3.3
18	3.5	3.5	3.5	3.7	4.0	3.8	3.6	3.6	3.6	3.6	3.3	3.3
19	3.5	3.5	3.5	3.8	4.0	3.8	3.6	3.6	3.6	3.6	3.3	3.2
20	3.5	3.5	3.5	3.8	4.0	3.8	3.6	3.6	3.6	3.6	3.3	3.2
21	3.5	3.5	3.5	3.8	4.0	3.8	3.6	3.6	3.6	3.6	3.3	3.2
22	3.5	3.5	3.5	3.8	4.0	3.8	3.6	3.6	3.6	3.5	3.3	3.3
23	3.5	3.4	3.6	3.9	4.1	3.8	3.6	3.6	3.6	3.3	3.3	3.3
24	3.5	3.4	3.6	3.9	4.1	3.8	3.6	3.6	3.6	3.3	3.3	3.3
25	3.5	3.4	3.6	4.0	4.1	3.7	3.6	3.6	3.6	3.3	3.3	3.3
26	3.5	3.5	3.6	4.0	4.1	3.7	3.6	3.6	3.6	3.3	3.3	3.3
27	3.5	3.5	3.6	4.0	4.1	3.7	3.6	3.6	3.6	3.3	3.3	3.3
28	3.5	3.5	3.6	4.0	4.1	3.7	3.6	3.6	3.6	3.3	3.3	3.3
29	3.5	.....	3.6	4.0	4.1	3.7	3.6	3.6	3.6	3.3	3.3	3.3
30	3.5	.....	3.6	4.0	4.1	3.7	3.6	3.6	3.6	3.3	3.3	3.3
31	3.5	.....	3.6	.....	4.1	.....	3.6	4.8	.....	3.3	.....	3.3

NOTE.—Stream does not freeze at this point during the winter months in sufficient quantity to materially affect the rating.

Station rating table for Blacksmith Fork near Hyrum, Utah, from January 1 to July 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.
Feet	*Second-feet*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	64	3.60	98	3.80	140	4.00	190
3.50	80	3.70	118	3.90	164	4.10	216

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during January to July, 1905. It is well defined throughout.

Station rating table for Blacksmith Fork near Hyrum, Utah, from August 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	18	3.70	94	4.10	189	4.50	304
3.30	29	3.80	115	4.20	216	4.60	336
3.40	42	3.90	138	4.30	244	4.70	369
3.50	57	4.00	163	4.40	273	4.80	402
3.60	75						

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during August to December, 1905, and the form of the 1904 curve. It is well defined between gage heights 3.2 feet and 4 feet.

Estimated monthly discharge of Blacksmith Fork near Hyrum, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	80	64	79.0	4,858
February	80	64	75.4	4,188
March	98	80	85.2	5,239
April	190	98	132.	7,855
May	216	164	187.	11,500
June	216	118	151.	8,985
July	98	98	98.0	6,026
August	402	75	85.5	5,257
September	402	75	228.	13,570
October	75	29	61.1	3,757
November	29	29	29.0	1,726
December	29	18	26.2	1,611
The year	402	18	103	74,570

NOTE.—Above estimates do not represent total flow of river. See Blacksmith Fork power plant race (pp. 34-35).

BLACKSMITH FORK POWER PLANT RACE, NEAR HYRUM, UTAH.

This station was established May 16, 1904, for the purpose of ascertaining the amount of water diverted around the regular gaging station at the tollgate and thus determining the total flow of the stream at that point. It is located about 600 feet down the canyon road from the tollgate at the mouth of the canyon, about 200 feet below the head of the canal or race, and about 500 feet south of the river station.

The channel is straight for 100 feet above and 200 feet below the station. Both banks are sufficiently high to prevent overflow. The bed of the stream is of gravel and is apparently permanent, except for probable slight changes near the edges. The depth varies from 2 to 3 feet and the velocity from 2 to 3 feet per second. Practically no ice forms in the channel at any time.

Discharge measurements are made from a foot plank placed across the stream and fastened at the ends to pieces of timber buried in the bank. The plank is marked at 1-foot intervals. The initial point for soundings is the north end of the plank, marked zero.

The gage, daily readings of which are made by Uriah Benson, is a 2 by 2½ inch iron bar driven vertically into the bed of the stream, supported at the top by the plank from which the measurements are made, and graduated by means of punch holes. The bench mark is a point on a projecting rock on the southeast corner of a rock house about 400 feet northwest from the station. It is marked with red paint. Elevation above zero of gage, 8.845 feet.

A description of this station, gage height, and discharge data and rating table are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 251–253.

Discharge measurements of Blacksmith Fork power plant race, near Hyrum, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 23	W. G. Swendsen	12.0	23	2.55	4.50	[illegible]
October 28	do	13.5	28	3.02	4.90	[illegible]

Daily gage height, in feet, of Blacksmith Fork power plant race near Hyrum, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	4.5	4.5	4.5	4.5	4.6	4.6	4.6	.....	4.4	4.9	4.9
2	4.5	4.5	4.5	4.5	4.5	4.6	4.6	4.6	.....	4.4	4.9	4.9
3	4.5	4.5	4.6	4.5	4.5	4.6	4.6	4.6	.....	4.4	4.9	4.9
4	4.45	4.5	4.6	4.5	4.5	4.6	4.6	4.6	.....	4.4	4.9	4.9
5	4.45	4.5	4.5	4.5	4.5	4.6	4.6	4.6	.....	4.4	4.9	4.9
6	4.45	4.5	4.5	4.6	4.5	4.6	4.6	4.6	.....	4.4	4.9	4.9
7	4.45	4.5	4.5	4.6	4.4	4.6	4.6	4.6	.....	4.4	4.9	4.9
8	4.45	4.5	4.5	4.6	4.4	4.6	4.6	4.6	.....	4.4	4.9	4.9
9	4.45	4.4	4.5	4.6	4.4	4.6	4.6	4.6	.....	4.4	4.9	4.9
10	4.5	4.4	4.5	4.6	4.4	4.5	4.6	4.6	.....	4.4	4.9	4.9
11	4.5	4.4	4.5	4.6	4.4	4.5	4.6	4.6	.....	4.4	4.9	4.5
12	4.5	4.4	4.5	4.6	4.4	4.5	4.6	4.6	.....	4.4	4.9	4.5
13	4.5	4.4	4.5	4.6	4.4	4.5	4.6	4.6	.....	4.4	4.9	4.5
14	4.5	4.5	4.5	4.6	4.4	4.5	4.6	4.6	.....	4.4	4.9	4.5
15	4.5	4.5	4.5	4.7	4.4	4.5	4.6	4.6	4.5	4.4	4.9	[illegible]
16	4.5	4.5	4.5	4.7	4.4	4.4	4.6	4.6	4.5	4.4	4.9	4.7
17	4.5	4.45	4.5	4.7	4.4	4.4	4.6	4.6	4.5	4.4	4.9	4.6
18	4.5	4.45	4.5	4.7	4.5	4.4	4.6	4.6	4.4	4.4	4.9	[illegible]
19	4.5	4.45	4.5	4.8	4.5	4.4	4.6	4.5	4.4	4.4	4.9	4.5
20	4.5	4.45	4.5	4.8	4.5	4.4	4.6	4.5	4.4	4.4	4.9	4.5
21	4.5	4.45	4.5	4.8	4.5	4.4	4.6	4.5	4.4	4.4	4.9	4.5
22	4.5	4.45	4.5	4.8	4.5	4.4	4.6	4.5	4.4	4.7	4.9	[illegible]
23	4.5	4.45	4.6	4.5	4.5	4.4	4.6	4.4	4.4	4.9	4.9	[illegible]
24	4.5	4.45	4.6	4.5	4.6	4.4	4.6	4.4	4.4	4.9	4.9	[illegible]
25	4.5	4.45	4.6	4.5	4.6	4.6	4.6	4.4	4.4	4.9	4.9	[illegible]
26	4.5	4.45	4.6	4.5	4.6	4.6	4.6	4.3	4.4	4.9	4.9	[illegible]
27	4.5	4.45	4.6	4.5	4.6	4.6	4.6	4.3	4.4	4.9	4.9	[illegible]
28	4.5	4.5	4.5	4.5	4.6	4.6	4.6	4.3	4.4	4.9	4.9	[illegible]
29	4.5	.....	4.5	4.5	4.6	4.6	4.6	4.3	4.4	4.9	4.9	[illegible]
30	4.5	.....	4.5	4.5	4.6	4.6	4.6	4.3	4.4	4.9	4.9	[illegible]
31	4.5	.....	4.5	.....	4.6	.....	4.6	.....	.....	4.9	.....	[illegible]

NOTE.—Flow not materially affected by ice conditions.

Station rating table for Blacksmith Fork power plant race near Hyrum, Utah, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.30	44	4.50	58	4.70	73	4.90	88
4.40	51	4.60	66	4.80	80		

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904-5. It is fairly well defined.

Estimated monthly discharge of Blacksmith Fork power plant race near Hyrum, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	58	54	57.2	3,517
February	58	51	55.2	3,066
March	66	58	59.8	3,677
April	80	58	65.3	3,886
May	66	51	57.6	3,542
June	66	51	59.9	3,564
July	66	66	66.0	4,058
August 1-30	66	44	59.8	3,558
September 15-30	58	51	52.3	1,659
October	88	51	62.5	3,843
November	88	88	88.0	5,236
December	88	58	74.5	4,581
The year	88	51	63.2	44,190

WEBER RIVER BASIN.

DESCRIPTION OF BASIN.

Weber River rises on the northern slope of the Uinta Mountains and flows in a tortuous course northwestward into Great Salt Lake.

The upper portion of the basin is very rough. The highest peaks, reaching an elevation of about 13,000 feet, are masses of sandstone and quartzite, entirely barren of vegetation and covered with snow for almost the entire year. Farther down the prevailing formation is limestone, overlain with sandstone and conglomerate. A thin layer of soil covers the basin in patches and supports small groves of fir and aspen. There are no extensive forests, meadows, or marshes. The greater part of the precipitation is in the form of snow, the melting of which is the chief source of the spring flood and early summer flow. A large part of the normal flow is derived from springs, which are well distributed over the area. Numerous tributaries, all short and confined to steep, narrow canyons, enter all along the course.

Between Oakley and Croyden the river traverses a very narrow valley comprising irrigated farms. The principal formation over this area is of conglomerate and sandstone, with but little loose and porous overlying soil except near the stream bed, where the deposit of bowlders and soil ranges from 10 to 20 feet in depth. The chief tributaries in this stretch of the river are Beaver Creek, which enters from the south about 6 miles below Oakley and drains a rough country about 71 square miles in extent; Chalk Creek, from the east, which drains a rough, dry country, about 248 square miles in area, and enters the Weber 15 miles above Croyden; and Lost Creek, which comes in from the east at a point about one-half

mile above the Devils Slide gaging station and has a watershed of 205 square miles. Gaging stations are maintained near the mouth of Chalk and Lost creeks.

Between Croyden and Plain City the stream flows in a well-defined channel through a comparatively narrow, steep canyon, with occasional stretches of narrow valley containing irrigated farming lands. The rock is a porous and badly fissured sandstone and conglomerate, with but little overlying soil. Near the mouth of the canyon the material is a very rough but compact limestone. East Creek, which enters near Morgan, discharges but little water into the river, as its flow is completely controlled by a storage reservoir about 5 miles above its mouth, the water being used for irrigation in the Morgan Valley, through which the Weber flows. After leaving the Wasatch Range the Weber enters the Great Salt Lake Valley, through which it flows in a well-defined channel with no overflow.

Ogden River joins the Weber about 8 miles above Plain City. It drains a rough and rugged limestone area, 363 square miles in extent, in the western slopes of the Wasatch Range. The main stream and its numerous short tributaries are confined to steep, narrow canyons. The entire normal flow of the stream is diverted for irrigation near the foot of the canyon about 3 miles above the mouth of the river, after being used for the development of power by the Utah Light and Railway Company. The flood and winter flow, therefore, is all that reaches the Weber, except for a small amount of seepage from the irrigated district. The city of Ogden also derives its water supply from Ogden River.

There are at present no storage reservoirs on the Weber, but a number of possibilities exist.

WEBER RIVER NEAR OAKLEY, UTAH.

This station was established October 22, 1904. It is located approximately 200 feet south of the main canyon road, about 3 miles above Oakley, Utah, and is above all diversions to the Kamas prairie region. The object of the station is to determine the amount of water available for diversion through the low Kamas Pass into Provo River, which is a part of the reclamation scheme in the development of the Weber River project.

Except for a slight depression, which probably carries a small amount of water during extreme floods, there is but one channel at all stages. The right bank for about 200 feet from the main channel is a low, wooded bottom, and is liable to overflow at extreme high water; the left bank is high and wooded. The bed of the stream, which is composed of large bowlders, gravel, and soil, is very rough, but thus far has been found to be permanent. Ice forms during December and January to a sufficient extent to render open-channel curves useless. The flow, which ranges from about 75 to 1,000 second-feet, reaches a maximum during May and a minimum during the winter months. The velocity ranges from 4 to 7 feet per second.

Discharge measurements are made by means of a cable and car. The cable is marked at 4-foot intervals with paint, the anchor bolt which supports the cable on the left bank being the initial point. A guy line stretched across the stream about 40 feet above the gaging section is found useful at all stages.

The gage, which is read daily by John Franson, a farmer, is of the inclined type and consists of three sections of 2-foot by one-half inch iron, fastened to the solid limestone ledge by means of bolts set in cement. It is graduated with chisel marks and paint to read vertically. The bench mark is a United States Geological Survey standard metallic plug, set in the ledge 0.5 foot from the anchor bolt used as initial point for soundings; elevation above zero of gage, 14.79 feet.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 253–254.

Discharge measurements of Weber River near Oakley, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 9	W. G. Swendsen	41	55	1.13	4.10	63
March 9	do	41	55	1.17	4.10	65
May 1	do	47	91	2.65	4.92	243
June 16	do	51	137	5.75	6.00	787
June 27	do	49	116	3.34	5.30	389
August 8	C. Tanner	42	57	1.26	4.20	72
August 18	W. D. Beers	42	62	1.10	4.18	68

Daily gage height, in feet, of Weber River near Oakley, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.05	4.1	4.15	4.95	6.0	5.0	4.3	4.05	4.35	4.15	4.05
2				4.15	5.05	6.15	4.95	4.3	4.05	4.3	4.15	4.0
3				4.2	5.05	6.3	4.9	4.3	4.05	4.3	4.15	4.0
4	5.4			4.25	4.9	6.4		4.3	4.05	4.25	4.15	4.0
5				4.3	4.8	6.45	4.8	4.3	4.05	4.25	4.15	
6				4.35	4.7	6.5	4.75	4.3	4.05	4.2	4.15	4.1
7				4.35	4.75	6.6	4.75	4.3	4.1	4.2	4.15	4.2
8		4.05		4.4	4.8	7.0	4.7	4.2	4.1	4.2	4.1	
9			4.1	4.4	4.8	6.8	4.7	4.2	4.1	4.2	4.1	4.8
10			4.1	4.35	4.75	6.3	4.7	4.2	4.1	4.2	4.1	
11	4.7		4.1	4.3	4.7	6.25	4.65	4.2	4.1	4.2	4.1	
12			4.15	4.3	4.7	6.3	4.65	4.2	4.1	4.2	4.1	
13			4.15	4.3	4.7	6.3	4.6	4.2	4.1	4.2	4.1	5.15
14			4.15	4.3	4.7	6.3	4.6	4.2	4.1	4.2	4.1	
15		5.1	4.15	4.35	4.7	6.25	4.65	4.15	4.1	4.2	4.1	
16			4.15	4.35	4.8	6.0		4.15	4.1	4.2	4.1	4.6
17			4.15	4.35	5.0	5.9	4.55	4.15	4.1	4.2	4.1	
18	4.5		4.2	4.4	5.2	5.7	4.55	4.15	4.1	4.2	4.1	
19			4.2	4.45	5.3	5.7	4.55	4.15	4.1	4.2	4.1	
20			4.2	4.45	5.35	5.8	4.5	4.15	4.1	4.2	4.1	4.75
21			4.2	4.45	5.4	5.75	4.5	4.15	4.1	4.2	4.1	
22		4.3	4.2	4.45	5.65	5.75	4.5	4.1	4.1	4.2	4.1	
23			4.15	4.55	5.7	5.7	4.5	4.1	4.1	4.2	4.1	4.85
24			4.15	4.6	5.7	5.6	4.45	4.1	4.1	4.15	4.1	
25	4.05		4.15	4.65	5.7	5.55	4.4	4.1	4.1	4.15	4.1	
26			4.15	4.75	5.75	5.4	4.35	4.1	4.1	4.1	4.1	
27			4.15	4.8	5.75	5.35	4.35	4.1	4.1	4.1	4.1	5.25
28			4.15	4.85	5.75	5.35	4.3	4.1		4.1	4.1	
29			4.15	4.9	5.8	5.2	4.3	4.1	4.2	4.15	4.1	
30			4.15	4.9	5.85	5.1	4.3	4.1	4.35	4.15	4.1	5.1
31			4.15		5.85		4.3	4.1		4.15		

NOTE.—Ice conditions January, February, and December noted on observer's records as follows:
January 4, ice at banks; river open in the center.
January 11, ice 1 foot thick at banks; 0.5 foot thick in the center.
January 18, ice broken up.
January 25, river clear.
February 1, river clear.
February 8, ice at banks; river open in the center.
February 15, ice 0.5 foot thick at banks; 0.25 foot thick in the center.
February 22, ice broken up.

March 1, river clear.
December 2, ice 0.3 foot thick at banks.
The following thicknesses of ice were recorded during December:

	Feet.		Feet.
December 9	0.7	December 23	0.7
December 13	.5	December 27	[illegible]
December 16	.6	December 30	1.15
December 20	.6		

Observer reports no anchor ice during December.
Gage readings during December are to the surface of the water in a hole cut in the ice.

Station rating table for Weber River near Oakley, Utah, from October 23, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.00	46	4.80	209	5.60	542	6.40	1,066
4.10	58	4.90	241	5.70	597	6.50	1,145
4.20	73	5.00	275	5.80	655	6.60	1,227
4.30	90	5.10	312	5.90	716	6.70	1,312
4.40	109	5.20	352	6.00	780	6.80	1,400
4.50	130	5.30	395	6.10	847	6.90	1,490
4.60	154	5.40	441	6.20	917	7.00	1,580
4.70	180	5.50	490	6.30	990		

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904–5. It is well defined between gage heights 4 feet and 6 feet.

Estimated monthly discharge of Weber River near Oakley, Utah, for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
October 23–31	82	82	82.0	1,464
November 1–26	100	66	72.1	3,718
1905.				
March	73	58	64.3	3,954
April	241	66	124	7,379
May	686	180	372	22,870
June	1,580	312	808	48,080
July	275	90	156	9,592
August	90	58	70.4	4,329
September	100	52	58.9	3,505
October	100	58	73.0	4,488
November	66	58	59.9	3,564
The period (1905)				107,800

NOTE.—Ice conditions November 27, 1904, to February 28, 1905, and December 2–31, 1905. Discharge interpolated on days when gage was not read.

WEBER RIVER NEAR CROYDEN, UTAH.

This station was established February 1, 1905. It is located about 1½ miles west of the town of Croyden, one-fourth mile below the junction of Lost Creek and Weber River, about three-fourths mile up the river from Croyden station on the Union Pacific Railroad, and 10 miles down the river from the town of Echo, just below the narrow canyon at the lower end of Henefer Valley.

The station is important as showing the amount of water available for storage in the Henefer basin, about 2 miles above the station, the development of which is a part of the reclamation scheme on the Weber River project. The winter records will be of special value, since the entire winter flow of the stream is at present discharged as waste into Great Salt Lake.

The channel is straight for about 1,000 feet above and 700 feet below the station. Both banks are sloping and sufficiently high to prevent overflow. The bed of the stream is of small, compact gravel and soil and is smooth and permanent. The velocity is moderate and uniform. The stream is shallow, especially during low water, the depth seldom exceeding 3 feet. There is a free flow, no obstruction to gage readings or discharge measurements existing. Information as to winter conditions is as yet rather indefinite.

Discharge measurements are made by means of a cable and car. The cable is marked at 5-foot intervals, the west face of a tree to which the east end of the cable is attached being the initial points for soundings.

The gage, which is read daily by Isaiah Stewart, a farmer who lives about 300 feet from the station, is an inclined piece of 4 by 4 inch fir, fastened to vertical posts near the water's edge and to a large cottonwood tree on the right bank about 75 feet above the cable. It is graduated to read vertically. The gage is referred to bench marks as follows: (1) A 3-inch metal post set 3½ feet in the ground on the bank 20 feet north from the gage; elevation above datum of gage, 8.41 feet; (2) a 30-penny nail driven in the tree which supports the upper end of the gage; elevation above gage datum, 7.87 feet.

Results of discharge measurements at this station are contained in Water-Supply Paper No. 133 of the United States Geological Survey, page 364.

Discharge measurements of Weber River near Croydon, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 31 [a]	W. G. Swendsen	90	95	2.04	1.90	193
March 7	do	95	126	2.67	2.22	337
May 2	do	102	192	3.73	2.85	703
June 17	do	100	213	4.10	3.05	875
June 28	do	91	113	2.45	2.10	277
August 19	W. D. Beers	89	56	.92	1.40	51
November 16	W. G. Swendsen	91	88	1.76	1.75	155

[a] Measurement made by wading.

Daily gage height, in feet, of Weber River near Croydon, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.95	1.95	1.95	2.65	2.85	1.9	1.4	1.4	1.65	1.8	1.8
2	.....	1.95	1.95	2.0	2.8	3.0	1.9	1.4	1.4	1.65	1.8	1.8
3	.....	1.95	2.0	2.0	2.75	3.1	1.85	1.4	1.45	1.65	1.8	1.85
4	.....	1.95	2.1	1.95	2.6	3.55	1.8	1.4	1.45	1.6	1.8	1.8
5	.....	1.9	2.2	1.95	2.6	3.6	1.75	1.4	1.5	1.6	1.8	1.7
6	.....	1.9	2.1	1.95	2.55	3.35	1.7	1.4	1.5	1.6	1.8	1.6
7	.....	1.9	2.2	1.95	2.5	3.3	1.65	1.4	1.5	1.6	1.8	1.65
8	.....	1.9	2.1	1.95	2.45	3.9	1.6	1.4	1.5	1.6	1.8	1.7
9	.....	1.85	2.1	1.95	2.5	3.9	1.55	1.4	1.5	1.6	1.8	1.7
10	.....	1.8	2.1	2.2	2.5	3.9	1.5	1.4	1.5	1.6	1.8	1.7
11	.....	1.8	2.1	2.3	2.4	3.4	1.5	1.5	1.5	1.6	1.8	1.65
12	.....	1.65	2.1	2.25	2.4	3.4	1.5	1.5	1.5	1.6	1.75	1.6
13	.....	1.65	2.05	2.2	2.4	3.4	1.5	1.5	1.5	1.6	1.75	1.6
14	.....	1.65	2.05	2.15	2.35	3.45	1.5	1.4	1.5	1.6	1.75	1.6
15	.....	1.65	2.0	2.15	2.3	3.5	1.5	1.4	1.5	1.6	1.75	1.6
16	.....	1.65	2.0	2.2	2.3	3.5	1.5	1.4	1.5	1.6	1.75	1.65
17	.....	1.8	1.95	2.25	2.3	3.0	1.55	1.4	1.5	1.6	1.8	1.6
18	.....	1.8	2.0	2.3	2.4	2.9	1.75	1.4	1.5	1.6	1.8	1.6
19	.....	1.8	2.1	2.3	2.6	2.8	1.9	1.4	1.5	1.6	1.8	1.6
20	.....	1.8	2.05	2.4	2.7	2.7	1.9	1.4	1.5	1.6	1.8	1.6
21	.....	1.8	2.0	2.6	2.8	2.7	1.9	1.4	1.5	1.6	1.8	1.6
22	.....	1.8	1.95	2.4	2.95	2.65	1.9	1.4	1.5	1.7	1.85	1.5
23	.....	1.9	1.9	2.2	2.95	2.6	1.8	1.4	1.5	1.75	1.8	1.6
24	.....	1.9	1.95	2.3	2.95	2.6	1.8	1.4	1.5	1.75	1.8	1.5
25	.....	1.95	2.0	2.3	2.9	2.4	1.8	1.4	1.5	1.75	1.8	1.6
26	.....	1.95	2.0	2.4	2.85	2.3	1.6	1.4	1.5	1.75	1.75	1.7
27	.....	1.95	2.0	2.6	2.85	2.2	1.5	1.4	1.5	1.75	1.8	1.6
28	.....	1.95	2.0	2.7	2.8	2.0	1.45	1.4	1.5	1.75	1.8	1.6
29	.....	.....	2.0	2.6	2.8	2.0	1.4	1.4	1.55	1.75	1.8	1.6
30	.....	.....	2.0	2.6	2.75	1.95	1.4	1.4	1.7	1.8	1.75	1.6
31	1.9	.....	1.95	.....	2.75	.....	1.4	1.4	.....	1.8	.....	1.6

NOTE.—Narrow strip of ice along edges during part of the winter months, but not enough to materially affect the flow.

Station rating table for Weber River near Croydon, Utah, from January 31 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	50	2.10	274	2.80	673	3.40	1,160
1.50	73	2.20	319	2.90	745	3.50	1,250
1.60	99	2.30	368	3.00	820	3.60	1,345
1.70	128	2.40	422	3.10	900	3.70	1,445
1.80	160	2.50	480	3.20	985	3.80	1,545
1.90	195	2.60	541	3.30	1,070	3.90	1,650
2.00	233	2.70	605				

NOTE.—The above table is applicable only for open channel conditions. It is based on seven discharge measurements made during 1905. It is well defined between gage heights 1.4 feet and 3.1 feet.

Estimated monthly discharge of Weber River near Croydon, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
February	214	114	175	9,719
March	319	135	246	15,130
April	605	214	346	20,590
May	782	368	574	35,290
June	1,650	214	876	52,130
July	195	50	119	7,317
August	73	50	52.2	3,210
September	128	50	73	4,344
October	160	99	115	7,071
November	178	144	157	9,342
December	178	73	112	6,887
The period				171,000

NOTE.—See note to gage-height table, p. 40.

WEBER RIVER NEAR PLAIN CITY, UTAH.

This station was established in 1903 by the State of Utah, under the direction of the State engineer, and was maintained under his direction until May 14, 1905, when it was taken up by the United States Geological Survey with the stipulation that the expense of daily gage readings should be defrayed by the State. It is located at the Plain City and West Weber highway bridge, about 10 miles west of Ogden, on the main road leading to Plain City and West Weber, below all points of diversion from and inflow to the stream.

The station is important as showing the amount of water discharged by the stream into Great Salt Lake, information necessary to the adjudication of water rights on the Ogden and Weber rivers.

Both banks are abrupt and sufficiently high to prevent overflow. The bed of the stream is composed of clay, sand, and gravel and is comparatively smooth, but it is liable to shift during flood seasons. At normal stages the stream is sluggish, but at high water the velocity ranges from 2 to 3.5 feet per second. The discharge at this point may vary from 5,500 second-feet during the spring flood to almost nothing during summer, when the entire flow is diverted above for irrigation, that passing the station being merely seepage from the irrigated lands tributary to the stream. Information as to ice conditions is as yet indefinite.

Discharge measurements are made from the upstream side of the bridge, which is a two-span steel truss structure, with a center pier of two metallic cylindrical caissons 4 feet in diameter and filled with concrete. The floor railing of the bridge is marked at 5-foot intervals, beginning at a zero mark which is coincident with the north face of the south abutment, this being the initial point for soundings.

The upstream face of the center bridge pier is graduated to feet and tenths, marked with white paint, and forms the gage, which is read daily by David O. Wadman. No bench marks have yet been established.

Discharge measurements of Weber River near Plain City, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 13	C. Tanner	127	564	2.45	8.30	1,382
May 18	W. G. Swendsen	132	789	2.40	9.30	1,894
September 8[a]	A. B. Larson	19	5.1	.92	2.80	4.7
November 17	W. G. Swendsen	105	110	1.04	4.00	115

[a] Measurement made 100 feet below station.

Daily gage height, in feet, of Weber River near Plain City, Utah, for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.5	3.2	2.8	2.8	3.2	4.1	4.5
2	.....	6.7	3.1	2.8	2.8	3.3	4.2	4.5
3	.....	6.7	3.0	2.8	2.8	3.3	4.2	4.5
4	.....	6.6	3.0	2.8	2.8	3.4	4.2	4.5
5	.....	6.8	3.0	2.8	2.8	3.3	4.2	4.5
6	.....	6.6	3.0	2.8	2.8	3.2	4.2	4.5
7	.....	6.4	2.9	2.8	2.8	3.1	4.2	4.5
8	.....	6.1	2.9	2.8	2.8	3.2	4.2	4.5
9	.....	6.8	2.9	2.8	2.8	3.2	4.2	4.6
10	.....	7.4	2.9	2.8	2.8	3.3	4.2	4.6
11	.....	6.8	2.9	2.8	2.8	3.3	4.2	4.6
12	.....	6.6	3.0	2.8	2.8	3.2	4.2	4.7
13	8.3	6.4	3.0	2.8	2.8	3.1	4.2	4.7
14	8.3	6.2	2.9	2.8	2.8	3.1	4.1	4.7
15	8.2	6.0	2.8	2.8	2.8	3.1	4.1	4.7
16	8.3	5.9	2.8	2.8	2.8	3.2	4.1	4.7
17	8.6	6.0	2.8	2.8	2.9	3.2	4.1	4.8
18	9.1	6.1	2.8	2.8	2.9	3.2	4.1	4.8
19	9.8	5.9	2.8	2.8	3.2	3.3	4.1	4.9
20	9.8	5.6	2.8	2.8	3.2	3.3	4.1	4.9
21	10.1	5.0	2.8	2.8	3.2	3.4	4.1	4.9
22	9.8	5.0	2.8	2.8	3.1	3.4	4.2	4.9
23	9.4	5.1	2.8	2.8	3.1	3.5	4.2	5.0
24	9.0	4.9	2.8	2.8	3.1	3.5	4.3	5.0
25	8.4	4.5	2.8	2.8	3.2	3.6	4.4	5
26	8.0	4.3	2.8	2.8	3.2	3.7	4.5	5.0
27	8.0	4.0	2.8	2.8	3.2	3.7	4.5	5.1
28	7.9	3.4	2.8	2.8	3.2	3.8	4.5	5.1
29	7.9	3.0	2.8	2.8	3.2	3.9	4.5	5.1
30	7.4	3.0	2.8	2.8	3.2	4.0	4.5	5.1
31	7.0	.....	2.8	2.8	.....	4.1	.....	5.1

NOTE.—Stream probably frozen after December 17.

Station rating table for Weber River near Plain City, Utah, from May 13 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	5	4.30	158	5.80	483	7.40	1,007
2.90	8	4.40	174	5.90	511	7.60	1,088
3.00	13	4.50	191	6.00	540	7.80	1,173
3.10	19	4.60	209	6.10	569	8.00	1,260
3.20	26	4.70	228	6.20	599	8.20	1,348
3.30	34	4.80	248	6.30	629	8.40	1,438
3.40	43	4.90	269	6.40	660	8.60	1,530
3.50	53	5.00	290	6.50	691	8.80	1,624
3.60	64	5.10	312	6.60	723	9.00	1,720
3.70	76	5.20	334	6.70	755	9.20	1,817
3.80	88	5.30	357	6.80	788	9.40	1,916
3.90	101	5.40	381	6.90	822	9.60	2,016
4.00	115	5.50	405	7.00	857	9.80	2,117
4.10	129	5.60	430	7.20	930	10.00	2,220
4.20	143	5.70	456				

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905 and the form of the 1903-4 curve. It is well defined.

Estimated monthly discharge of Weber River near Plain City, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 13-31	2,272	857	1,544	58,190
June	1,007	13	501	29,810
July	26	5	8.3	510
August	5	5	5.0	307
September	26	5	12.9	768
October	129	19	45.4	2,792
November	191	129	148	8,807
December 1-17	248	191	208	7,014
The period				108,100

LOST CREEK NEAR CROYDEN, UTAH.

Lost Creek, which enters Weber River near the town of Croyden, drains an area of 205 square miles. The basin is generally rough and barren, the rocks being conglomerate and sandstone, with a few outcropping ledges of loose, porous limestone and but a thin layer of soil. The stream flows for the most part in a narrow canyon, with occasional small flats devoted to irrigated farms. Near the head the creek receives numerous tributaries, all short and confined to steep, narrow canyons. The normal flow comes principally from springs, well distributed over the entire watershed, but the spring flood is caused by the melting of snow, which forms the greater part of the precipitation. There are no forests, swamps, or meadows along the stream. A few undeveloped storage sites exist in the upper portion of the basin.

The station was established February 3, 1905. It is located about 150 feet above the junction of Lost Creek with Weber River, about 10 miles down Weber River from Echo, and about 1½ miles west of the town of Croyden on the main road up Lost Creek. The data derived are of value in connection with the amount of water to be diverted into the Henefer reservoir.

The channel is slightly curved for about 100 feet above and 75 feet below the station. The right bank is steep and high; the left bank is sloping and near the channel is sufficiently high to prevent overflow, but about 50 feet back there is an old channel, originally occupied by the stream, which may contain some water during extreme floods. The bed of the creek is composed of gravel and sand and is liable to shift at flood stages. A slight raise in the bed about 20 feet below the gage causes a small riffle. The velocity is moderate and fairly uniform.

Discharge measurements are made by wading. The section is located about 20 feet above the gage and is marked by a 4 by 4 inch by 2-foot stake, the initial point for soundings, driven into the right bank about 6 feet from the edge.

The gage, which is read daily by Isaiah Stewart, a farmer, is an inclined 4 by 4 inch by 12-foot piece of Oregon fir, fastened to vertical posts embedded in the right bank. As the bank is composed of loose gravel and sand the permanency of the gage is uncertain. The bench mark is a 3-inch metallic post, set 3½ feet in the ground at a point 50 feet north east of the gage and 15 feet northwest of the initial stake; elevation above gage datum 8.71 feet.

Discharge measurements of Lost Creek near Croyden, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 2	W. G. Swendsen	30	24	1.00	2.85	24
May 2 [a]	do	27	72	2.53	3.50	18[illegible]
June 28	do	26	15	1.00	2.68	15
August 19	W. D. Beers	20	12	.82	2.60	10

[a] Gaging made at bridge.

Daily gage height, in feet, of Lost Creek near Croyden, Utah, for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.85	2.85	3.4	2.75	2.7	2.6	2.6	2.55	2.55	2.6
2	2.85	2.85	2.85	3.5	2.75	2.7	2.6	2.6	2.55	2.55	2.65
3	2.85	2.85	2.85	3.45	2.75	2.7	2.6	2.6	2.55	2.55	2.65
4	2.85	2.85	2.85	3.35	2.75	2.7	2.6	2.6	2.55	2.55	2.55
5	2.8	2.85	2.85	3.3	2.75	2.7	2.6	2.6	2.55	2.55	2.65
6	2.8	2.85	2.85	3.3	2.75	2.7	2.6	2.6	2.55	2.55	2.65
7	2.8	2.85	2.85	3.25	2.75	2.7	2.6	2.6	2.55	2.55	2.65
8	2.8	2.85	2.85	3.2	2.8	2.7	2.6	2.6	2.55	2.55	2.65
9	2.8	2.85	2.9	3.25	2.8	2.65	2.6	2.6	2.55	2.55	2.65
10	2.8	2.85	3.0	3.25	2.8	2.6	2.6	2.6	2.55	2.55	2.65
11	2.8	2.85	2.95	3.2	2.8	2.6	2.6	2.6	2.55	2.55	2.65
12	2.7	2.85	2.95	3.2	2.75	2.6	2.6	2.6	2.55	2.55	2.6
13	2.7	2.85	2.9	3.2	2.75	2.6	2.6	2.6	2.55	2.55	2.6
14	2.75	2.85	2.9	3.2	2.75	2.6	2.6	2.6	2.55	2.55	2.6
15	2.75	2.85	2.9	3.2	2.75	2.6	2.6	2.6	2.55	2.55	2.6
16	2.75	2.85	2.9	3.2	2.75	2.6	2.6	2.6	2.55	2.55	2.6
17	2.8	2.85	3.0	3.2	2.75	2.6	2.6	2.6	2.55	2.55	2.6
18	2.8	2.85	3.0	3.25	2.75	2.6	2.6	2.6	2.55	2.55	2.6
19	2.8	2.85	3.0	3.3	2.75	2.6	2.6	2.6	2.55	2.55	2.6
20	2.8	2.85	3.0	3.3	2.75	2.6	2.6	2.6	2.55	2.55	2.6
21	2.8	2.85	3.1	3.3	2.7	2.6	2.6	2.6	2.55	2.55	2.6
22	2.8	2.85	3.05	3.35	2.7	2.6	2.6	2.6	2.55	2.6	2.6
23	2.85	2.85	3.0	3.35	2.7	2.6	2.6	2.6	2.55	2.6	2.6
24	2.85	2.85	3.1	3.35	2.7	2.6	2.6	2.6	2.55	2.6	2.6
25	2.85	2.85	3.1	3.3	2.7	2.6	2.6	2.55	2.55	2.6	2.6
26	2.85	2.85	3.15	3.2	2.7	2.6	2.6	2.55	2.55	2.6	2.6
27	2.85	2.85	3.2	3.2	2.7	2.6	2.6	2.55	2.55	2.6	2.6
28	2.85	2.85	3.3	2.8	2.7	2.6	2.6	2.55	2.55	2.6	2.6
29	.....	2.85	3.3	2.8	2.7	2.6	2.6	2.55	2.55	2.6	2.6
30	.....	2.85	3.3	2.8	2.7	2.6	2.6	2.55	2.55	2.6	2.6
31	.....	2.85	.....	2.75	.....	2.6	2.6	.....	2.55	.....	2.6

NOTE.—Open-channel conditions throughout the year.

CHALK CREEK AT COALVILLE, UTAH.

Chalk Creek joins Weber River at Coalville. Its basin is rough and barren, the rocks being chiefly sandstone and conglomerate, with but little overlying soil. Small springs scattered over the entire area furnish the principal part of the normal flow, while the spring and flood run-off is derived from melting snow. The stream has few tributaries. There are no swamps, meadows, or forests in the area. Small tracts of irrigated lands lie near the mouth of the canyon. The water supply of the town of Coalville comes mostly from this stream.

The gaging station was established October 23, 1904. It is located at a foot bridge on the main road leading north, one-eighth mile from the county court-house at Coalville.

The channel is slightly curved and somewhat irregular for about 150 feet above the station. Below it is wider and is straight for about 100 feet. Both banks are sufficiently high to prevent overflow. The bed of the stream is composed of small cobbles and is somewhat rough, but apparently permanent. There is but one channel at all stages, broken during high water by the supporting piles of the bridge. The velocity is moderate and the stream shallow.

Discharge measurements are made from the foot bridge. The initial point for soundings is the zero mark near the left end of the bridge.

The gage, which is read daily by Miss Eva Rees, consists of a vertical staff attached to a pile near the right bank of the stream. The bench mark is a cut on the south corner of the stone abutment of the highway bridge; elevation, 0.00 feet above gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 254–255.

Discharge measurements of Chalk Creek at Coalville, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 8	W. G. Swendsen	34	21	0.77	1.42	16
May 1	do	44	64	2.45	2.25	154
June 16	do	32	42	1.58	1.86	67
June 27	do	38	28	.80	1.50	22

Daily gage height, in feet, of Chalk Creek at Coalville, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.5	1.5	1.5	2.19	2.38	1.25	1.2	1.13	1.37	1.47	1.5
2	.....	1.5	1.55	1.63	2.18	2.38	1.25	1.2	1.13	1.32	1.46	1.5
3	1.5	.....	1.55	1.57	2.68	2.32	1.24	1.19	1.13	1.31	1.52	1.5
4	.....	1.5	1.52	1.57	2.03	2.4	1.23	1.18	.....	1.42	1.6	1.46
5	.....	.....	1.52	1.6	1.97	2.32	1.22	1.18	1.13	1.44	1.53	1.45
6	.....	1.5	.....	1.6	1.96	2.19	1.2	1.18	1.13	1.43	1.51	.....
7	1.4	.....	1.52	1.62	1.98	2.2	1.2	1.19	1.15	1.45	1.53	.....
8	.....	.....	1.42	.....	2.03	2.27	1.18	1.19	1.2	.....	1.52	1.4
9	.....	.....	1.5	1.68	1.98	2.35	1.2	1.17	1.2	1.37	1.55	.....
10	.....	1.5	1.5	1.8	1.93	2.25	1.23	1.2	.....	1.37	1.43	.....
11	1.4	1.5	1.54	1.66	1.88	2.15	1.21	1.2	1.2	1.47	1.44	.....
12	.....	.....	1.54	1.65	1.86	2.02	1.17	1.19	1.2	1.47	1.39	1.35
13	.....	.....	1.54	1.69	1.87	2.03	1.2	1.17	1.18	1.45	1.43	.....
14	1.4	1.5	1.56	1.71	1.87	2.02	1.28	1.18	1.19	.....	1.53	.....
15	.....	.....	1.54	1.67	1.91	1.99	.....	1.2	1.2	.....	1.43	1.37
16	.....	.....	1.56	1.73	2.02	1.95	1.21	1.17	1.2	1.45	1.37	1.4
17	.....	1.5	1.55	1.76	2.17	1.92	1.33	1.17	.....	.....	1.55	.....
18	1.51	.....	1.58	1.73	2.4	1.91	1.35	1.15	1.2	1.55	1.5	.....
19	1.52	.....	1.62	1.82	2.4	1.81	1.4	1.15	1.2	1.57	1.35	1.38
20	.....	1.5	1.6	1.83	2.6	1.8	1.57	1.15	1.2	1.55	1.5	.....
21	1.52	.....	1.57	1.81	2.55	1.68	1.54	1.15	1.2	1.55	1.5	1.38
22	.....	.....	1.5	1.8	2.47	1.67	1.52	1.15	1.2	1.57	1.5	.....
23	.....	1.5	1.62	1.8	2.47	1.67	1.53	1.15	1.2	1.56	1.43	.....
24	.....	1.5	1.6	1.82	2.4	1.67	.....	1.15	1.2	1.53	1.43	.....
25	1.5	1.5	1.52	1.9	2.3	1.62	1.5	1.15	1.2	.....	1.36	.....
26	.....	1.5	1.56	1.98	2.3	1.55	.....	1.15	1.22	1.55	1.33	.....
27	.....	1.5	1.55	2.05	2.3	1.55	1.2	1.15	1.2	1.55	.....	.....
28	1.5	.....	1.5	2.1	2.37	1.46	1.23	1.15	.....	1.55	.....	1.4
29	.....	.....	1.53	2.1	2.25	1.36	1.21	1.15	1.3	1.55	.....	.....
30	1.5	.....	1.6	2.11	2.2	1.28	1.17	.....	1.4	1.56	1.3	1.45
31	1.5	.....	1.6	.....	2.3	.....	1.19	1.13	.....	1.58	.....	.....

NOTE.—Ice conditions January 1 to February 22 and December 6-31.

Station rating table for Chalk Creek at Coalville, Utah, from October 23, 1904, to December 31 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	3	1.50	22	1.90	74	2.30	168
1.20	6	1.60	31	2.00	94	2.40	197
1.30	10	1.70	43	2.10	116	2.50	227
1.40	15	1.80	57	2.20	141	2.60	258

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904-5. It is well defined between gage heights 1.4 feet and 2.25 feet.

Estimated monthly discharge of Chalk Creek at Coalville, Utah, for 1904 and 1905.

[Drainage area, 248 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
October 23-31	22	20	21.6	386	0.087	0.029
November	31	8	20.2	1,202	.081	.090
1905.						
February 23-28	22	22	22.0	262	.089	.020
March	33	16	26.0	1,599	.105	.121
April	118	22	55.4	3,296	.223	.249
May	274	68	139	8,547	.560	.646
June	197	9	95.2	5,665	.384	.428
July	28	4.8	11.0	676	.044	.051
August	6	3.6	4.8	295	.019	.022
September	15	3.6	5.9	351	.024	.027
October	29	10	20.9	1,285	.084	.097
November	31	10	18.7	1,113	.075	.084
December 1-5	22	18	20.6	204	.083	.015
The period (1905)				23,290		

NOTE.—Ice conditions December, 1904, January 1 to February 22, and December 6-31, 1905. Discharge interpolated on days when gage was not read.

AMERICAN FORK BASIN.

AMERICAN FORK NEAR AMERICAN FORK, UTAH.

American Fork drains a rough, broken, limestone country, comprising a portion of the western slopes of the Wasatch Mountains. The stream is confined to a steep, narrow canyon, and receives few tributaries, its normal flow being derived almost entirely from springs. There are no storage reservoirs, swamps, or lakes in the area, and the timber growth is scanty. The entire summer flow is diverted for irrigation near the mouth of the canyon; the winter flow and a part of the spring flood is discharged into Utah Lake.

The station was established May 21, 1900. It is located about 6 miles northeast of the town of American Fork, Utah, 50 feet north of the county road, and 200 feet southwest of the electric power house.

Measurements are made over a sharp-crested rectangular weir. A nail driven into the weir structure just south of the south opening, and level with the crest of the weir, serves to determine gage heights, which are read daily by Peter Anderson. During floods considerable gravel is deposited in the weir approach, making measurements at such times erroneous; this condition is partly overcome by raising the crest and sluicing out the deposit.

Information in regard to this station is contained in the following publication, of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, p 469; WS 51, p 417-418; 66, p 124; 100, p 139; 133, p 259.
Discharge. WS 51, p 418; 66, p 124; 100, p 140.
Discharge, daily mean. WS 133, p 260.
Discharge, monthly: Ann 13, iii, p 96; 20, iv, p 469; WS 75, p 195; 133, pp 260-261.
Discharge, yearly: Ann 13, iii, p 99, 20, iv, p 61.
Gage heights. WS 51, p 419; 66, p 124; 100, p 140; 133, p 259.
Rating table: WS 66, p 176; 12, ii, p 361.

Daily gage height, in feet, of American Fork near American Fork, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.30	0.38	0.40	0.38	0.90	1.36	0.90	0.48	0.36	0.43	0.37	0.33
2	.40	.39	.40	.38	.84	1.34	.85	.48	.36	.42	.37	.34
3	.39	.38	.41	.38	.76	1.45	.85	.47	.....	.41	.37	.....
4	.40	.37	.41	.38	.73	1.39	.79	.47	.38	.41	.37	.31
5	.41	.....	.41	.41	.69	1.39	.79	.47	.39	.40	.37	.31
6	.39	.37	.42	.43	.66	1.39	.77	.46	.40	.39	.37	.29
7	.39	.38	.44	.52	.66	1.41	.75	.46	.39	.39	.37	.29
8	.37	.37	.43	.52	.68	1.57	.78	.46	.38	.40	.37	.31
9	.38	.37	.43	.....	.69	1.45	.77	.45	.37	.39	.36	.31
10	.38	.38	.43	.58	.68	1.35	.74	.44	.36	.39	.36	.31
11	.37	.38	.43	.52	.60	1.35	.75	.44	.36	.39	.36	.31
12	.38	.23	.44	.50	.60	1.41	.73	.43	.35	.38	.36	.31
13	.38	.33	.44	.49	.62	1.50	.72	.41	.35	.38	.36	.31
14	.38	.37	.44	.50	.63	1.50	.71	.41	.35	.38	.36	.31
15	.38	.37	.44	.51	.64	1.47	.68	.40	.35	.38	.36	.31
16	.38	.37	.44	.53	.76	1.37	.65	.40	.35	.38	.35	.31
17	.38	.37	.43	.53	.97	1.34	.65	.40	.35	.37	.35	.31
18	.38	.37	.43	.53	1.01	1.14	.62	.40	.35	.36	.35	.31
19	.37	.37	.43	.56	1.11	1.08	.60	.39	.35	.36	.35	.31
20	.37	.37	.43	.55	1.16	1.14	.56	.38	.35	.36	.36	.31
21	.38	.37	.42	.55	1.19	1.17	.56	.38	.37	.38	.36	.30
22	.38	.37	.43	.54	1.16	1.27	.55	.38	.37	.38	.36	.30
23	.38	.37	.43	.56	1.16	1.24	.53	.38	.37	.38	.36	.30
24	.37	.37	.44	.59	1.16	1.12	.52	.41	.37	.38	.35	.31
25	.37	.38	.43	.62	1.28	1.10	.51	.39	.38	.38	.35	.30
26	.37	.39	.45	.71	1.26	1.05	.49	.37	.37	.38	.35	.32
27	.37	.39	.45	.72	1.27	1.01	.49	.38	.37	.38	.33	.30
28	.37	.40	.45	.74	1.16	.96	.49	.38	.47	.38	.30	.32
29	.37	.....	.45	.75	1.11	.94	.48	.41	.52	.38	.30	.32
30	.37	.....	.43	.86	1.10	.92	.48	.38	.45	.38	.32	.30
31	.37	.....	.43	.....	1.32	.....	.49	.38	.....	.38	.....	.32

NOTE.—January 1 to March 29 and September 28 to December 31, crest 30.5 feet long; March 30 and 31, crest 33 feet long; April 1 to September 27, crest 36.5 feet long. Ice conditions on the river affect the flow at the weir but little.

Daily discharge, in second-feet, of American Fork near American Fork, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	25	24	26	28	104	193	104	40	26	29	23	19
2	26	25	26	28	94	189	95	40	26	28	23	20
3	25	24	27	28	81	212	95	39	[a] 27	27	23	[a] 19
4	26	23	27	28	76	199	85	39	28	27	23	18
5	27	[a] 23	27	32	70	199	85	39	30	26	23	18
6	25	23	28	35	65	199	82	38	31	25	23	16
7	25	24	30	46	65	203	79	38	30	25	23	16
8	23	23	29	46	68	239	84	38	28	26	23	18
9	24	23	29	[a] 50	70	212	82	37	27	25	22	18
10	24	24	29	54	68	191	77	35	26	25	22	18
11	23	24	29	46	56	191	79	35	26	25	22	18
12	24	11	30	43	56	203	76	34	25	24	22	18
13	24	19	30	42	59	223	74	32	25	24	22	18
14	24	23	30	43	61	223	73	32	25	24	22	18
15	24	23	30	44	62	217	68	31	25	24	22	18
16	24	23	30	47	81	195	64	31	25	24	21	18
17	24	23	29	47	116	189	64	31	25	23	21	18
18	24	23	29	47	123	148	59	31	25	22	21	18
19	23	23	29	51	142	136	56	30	25	22	21	18
20	23	23	29	50	152	148	51	28	25	22	22	18
21	24	23	28	50	158	154	51	28	27	24	22	17
22	24	23	29	48	152	174	50	28	27	24	22	17
23	24	23	29	51	152	168	47	28	27	24	22	17
24	23	23	30	55	152	144	46	32	27	24	21	18
25	23	24	29	59	176	140	44	30	28	24	21	17
26	23	25	31	73	172	131	42	27	27	24	21	18
27	23	25	31	74	174	123	42	28	27	24	19	17
28	23	26	31	77	152	114	42	28	33	24	17	18
29	23	.....	31	79	142	111	40	32	38	24	17	18
30	23	.....	31	97	140	107	40	28	31	24	18	17
31	23	.....	31	.....	184	.....	42	28	.....	24	.....	18

[a] Discharge interpolated.

Estimated monthly discharge of American Fork near American Fork, Utah, for 1905.

[Drainage area, 66 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	27	23	24.0	1,476	0.364	0.420
February	26	11	23.0	1,277	.348	.362
March	31	26	29.2	1,795	.442	.510
April	97	28	49.9	2,969	.756	.844
May	184	56	110	6,763	1.67	1.92
June	239	107	176	10,470	2.67	2.98
July	104	40	65.1	4,003	.986	1.14
August	40	27	32.7	2,011	.495	.571
September	38	25	27.4	1,630	.415	.463
October	29	22	24.5	1,506	.371	.428
November	23	17	21.5	1,279	.326	.364
December	20	16	17.8	1,094	.270	.311
The year	239	11	50.1	36,270	.759	10.31

PROVO RIVER BASIN.

DESCRIPTION OF BASIN.

Provo River has its source in the Uinta Mountains and flows westward in a steep, narrow canyon until it reaches Heber or Provo Valley, through which it winds in a well-defined channel. Leaving the valley, it flows southwestward, cutting through the Wasatch Range in another steep, narrow, and extremely rough canyon, and finally discharging its surplus waters into Utah Lake.

In the mountain regions the principal rock is a compact limestone. Except in Heber Valley there is but little soil in any portion of the basin. Small groves of fir and aspen are, however, scattered over almost the entire area, and there is a light growth of underbrush. There are no extensive forests, meadows, or marshes. In the canyons the stream receives numerous short and swift tributaries, deriving their principal supply from springs, but a part also from the melting of the snow, which covers portions of the high mountains during the entire year. The highest peaks reach elevations of about 13,000 feet.

Heber Valley, which comprises an area of about 20 square miles, is an irrigated farming district, composed of a deposit of loose bowlders, gravel, and soil, very porous. Most of the water comes from the main stream, though a part is received from small creeks which enter the valley from the south. The most important of these is Daniels Creek, into which some water is diverted from Strawberry River, a tributary of Green River, by three small canals in low passes at the head of the creek.

There are a few lakes at the head of the river, but they are so small that they probably have little effect in regulating the flow. There is no storage on the stream at present, but a few possibilities exist which will doubtless be developed in the future, as the entire stream, after being used at the mouth of the canyon for the development of power, is now utilized on lands in the vicinity of Utah Lake, and the supply is altogether insufficient.

PROVO RIVER ABOVE TELLURIDE POWER COMPANY'S DAM, NEAR PROVO, UTAH.

This station was established March 1, 1905. It is located about three-fourths of a mile up the river from Upper Falls, a station on the Provo Canyon branch of the Rio Grande Western Railway, about 4 miles above the mouth of the canyon and 800 feet south of the canyon road, in J. W. Slick's pasture. It is about one-half mile above the Telluride Power Company's dam and above all diversions into Utah Lake Valley. The object of the station is the collection of data concerning the amount of water passing from the river into this valley.

The channel has a slight uniform curvature for about 200 feet above and 300 feet below the station, describing approximately the arc of a circle. Both banks are sufficiently high to prevent overflow; the left bank is formed by the Rio Grande Western Railway grade. The bed of the stream is composed of well-compacted rock and soil, is comparatively smooth, and is not liable to shift, but a slight growth of moss occurs from the time of the spring flood until freezing weather. The velocity is low near the right bank, but increases uniformly to a point near the left. The discharge may vary from 100 to 1,400 second-feet. Conditions of free flow exist except for a very short distance near the left bank.

Discharge measurements are made by means of a cable and car. The cable is marked at 4-foot intervals, beginning at the north support, which is the initial point for soundings.

Daily gage readings are made, without expense to the Geological Survey, by the Telluride Power Company, the observations being under the direction of E. A. Briscoe, an engineer at the power house about 4 miles below the station. The gage is of the inclined type and consists of a 4-by-4 inch by 16-foot fir, bolted to a vertical cedar post embedded in the bank at the water's edge and to a box-elder stump at the shore end, about 25 feet upstream from the cable on the left bank. It is graduated with saw cuts and paint to read vertically. The gage is referred to bench marks as follows: (1) A 4-inch iron pipe with a metallic cap, set 3½ feet in the ground at a point 12 feet from the north cable post, under a fence; this has an elevation of 7.31 feet above gage datum and is so stamped on the top. (2) A project-

ing point, marked with black paint, on a limestone ledge in a railroad cut about a foot above the track and 22 feet upstream from the line of the gage; elevation, 17.18 feet above datum of gage.

Discharge measurements of Provo River above Telluride Power Company's dam, near Provo, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 28 [a]	H. S. Kleinschmidt	70	144	1.51	3.73	217
March 3 [b]	W. G. Swendsen	69	130	2.26	3.93	294
May 13	do	71	132	2.35	4.05	309
June 14	Hoyt & Swendsen	75	223	3.68	5.30	820
June 22	do	71	166	2.82	4.43	469
August 28 [c]	A. B. Larson	67	94	1.46	3.62	136
September 27 [c]	W. G. Swendsen	67	85	1.64	3.57	139

[a] Measurement by wading 35 feet above cable.
[b] Measurement by wading approximately at present cable station.
[c] Growing moss changed conditions.

Daily gage height, in feet, of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.85	3.9	3.85	4.4	5.15	4.0	3.9	3.7	3.65	3.75	3.9
2	4.1	4.0	3.85	4.4	5.4	3.95	3.85	3.6	3.65	3.75	3.9
3	3.9	4.0	3.85	4.5	5.5	3.95	3.9	3.6	3.65	3.75	3.9
4	3.9	4.1	3.85	4.4	5.6	3.95	3.8	3.6	3.65	3.75	3.9
5	3.9	4.05	3.8	4.2	5.77	3.95	3.8	3.6	3.65	3.75	3.85
6	3.85	4.05	3.85	4.1	5.5	3.95	3.8	3.6	3.65	3.75	3.65
7	3.85	4.0	3.85	4.1	5.4	3.95	3.8	3.6	3.65	3.75	3.6
8	3.85	3.95	3.85	4.1	5.8	3.95	3.8	3.6	3.55	3.8	3.55
9	3.8	3.9	3.85	4.25	6.1	3.95	3.8	3.6	3.65	3.8	3.55
10	3.8	3.9	3.95	4.2	5.9	3.95	3.8	3.6	3.6	4.0	3.6
11	3.8	3.9	4.1	4.2	5.4	3.95	3.85	3.6	3.6	4.0	3.6
12	5.8	3.9	4.0	4.1	5.15	3.95	3.85	3.6	3.6	3.8	3.6
13	5.1	3.9	4.0	4.1	5.15	3.95	3.8	3.6	3.6	3.85	3.6
14	5.1	3.9	4.0	4.1	5.2	3.95	3.75	3.6	3.6	3.85	3.6
15	4.7	3.9	4.0	4.1	5.1	4.0	3.75	3.6	3.6	3.85	3.8
16	4.1	3.9	4.1	4.0	5.05	3.95	3.8	3.6	3.6	3.85	3.8
17	3.8	3.85	4.1	4.1	4.9	3.95	3.8	3.6	3.6	3.85	3.8
18	3.8	3.85	4.1	4.25	4.8	3.95	3.7	3.6	3.6	3.9	3.8
19	3.8	3.85	4.1	4.4	4.6	3.9	3.8	3.6	3.6	3.9	3.8
20	3.8	3.9	4.1	4.45	4.45	3.9	3.7	3.6	3.6	3.9	3.8
21	3.8	3.9	4.15	4.6	4.4	3.9	3.7	3.6	3.6	3.9	3.7
22	3.8	4.0	4.1	4.7	4.45	3.9	3.7	3.55	3.6	3.9	3.7
23	3.8	3.95	4.1	4.8	4.4	3.9	3.7	3.55	3.65	3.9	3.7
24	3.8	3.9	4.1	4.85	4.35	3.9	3.7	3.55	3.65	3.85	3.8
25	3.8	3.9	4.1	4.8	4.35	3.9	3.7	3.6	3.65	3.85	3.8
26	3.8	3.85	4.3	4.8	4.4	3.85	3.7	3.6	3.65	3.85	3.8
27	3.85	4.0	4.3	4.9	4.1	3.85	3.65	3.6	3.65	3.85	3.8
28	3.9	3.9	4.3	5.0	4.05	3.85	3.7	3.55	3.65	3.9	3.8
29	.....	3.9	4.3	5.1	4.0	3.85	3.65	3.7	3.7	3.9	3.8
30	.....	3.95	4.5	4.9	4.0	3.85	3.7	3.7	3.7	3.9	3.8
31	.....	3.9	.....	4.85	.....	3.9	3.7	.....	3.75	.....	3.8

NOTE.—Ice jam February 12, 13, and 14. Open-channel conditions during the remainder of the winter months.

Daily discharge, in second-feet, of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	254	269	254	446	763	301	245	163	159	193	244
2	335	301	254	446	879	285	237	135	159	194	245
3	269	301	254	485	926	285	243	136	160	194	245
4	269	335	254	446	973	285	212	136	160	194	245
5	269	318	238	371	1,054	284	211	137	160	194	230
6	254	318	254	335	926	284	210	137	160	194	170
7	254	301	254	335	879	283	209	138	160	194	156
8	254	285	254	335	1,069	282	208	138	132	210	143
9	238	269	254	389	1,215	281	207	139	161	210	143
10	238	269	285	371	1,117	280	206	139	147	273	157
11	238	269	335	371	879	280	221	140	147	273	157
12	238	269	301	335	763	279	220	140	147	210	157
13	238	269	301	335	763	278	203	141	147	226	157
14	238	269	301	335	786	277	187	141	147	227	158
15	238	269	301	335	740	292	187	142	148	227	216
16	238	269	335	301	717	275	200	142	148	227	216
17	238	254	335	335	651	274	200	143	148	227	216
18	238	254	335	389	608	273	168	143	148	242	216
19	238	254	335	446	525	256	197	144	148	242	216
20	238	269	335	466	466	255	167	144	148	243	216
21	238	269	353	525	446	255	166	145	149	243	187
22	238	301	335	566	466	254	165	132	149	243	187
23	238	285	335	608	446	254	164	133	163	243	187
24	238	269	335	630	427	253	163	133	163	228	217
25	238	269	335	608	427	253	162	147	163	228	217
26	238	254	408	608	446	236	161	147	163	229	218
27	254	301	408	651	335	236	144	147	164	229	218
28	269	269	408	695	318	237	158	132	164	244	218
29	.....	269	408	740	301	237	146	173	178	244	218
30	.....	285	485	651	301	238	162	173	178	244	218
31	.....	209	.....	630	.....	245	162	.....	193	.....	218

NOTE.—Discharge February 12-16 assumed as 238 second-feet, on account of ice conditions. A rating table was used to obtain daily discharge February 1 to July 4. The daily discharge July 5 to December 31 was obtained by indirect methods, as applied to shifting channels. The effect produced by the existence of moss at this station seems to be about the same as by a shifting of the bed, i. e., the moss seems to collect sediment and make a soft coating over the bed of the stream, but does not affect flow near surface.

Estimated monthly discharge of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
February	335	238	249	13,830
March	335	254	279	17,160
April	485	238	319	18,980
May	740	301	468	28,790
June	1,215	301	687	40,880
July	301	236	267	16,420
August	245	144	190	11,680
September	173	132	143	8,510
October	193	132	157	9,654
November	273	193	226	13,450
December	245	143	200	12,300
The period				191,600

PROVO RIVER AT MOUTH OF CANYON, NEAR PROVO, UTAH.

This station was established July 27, 1889. It is located about 6 miles north of Provo, about 1,000 feet above Olmstead station, on the Provo Canyon branch of the Rio Grande Western Railway, and 1,200 feet above the power house of the Telluride Power Company.

The station was originally established to determine the total flow of the Provo above all diversions to Utah Lake Valley; but since that time a small canal has been taken out about 3 miles above the station and the system of the Telluride Power Company has been extended by a new flume line of sufficient capacity to divert the entire normal flow of the stream. The power plant of the Telluride Power Company has been rebuilt at a point about 1,200 feet below the station, the tailrace discharging directly into the canals at the mouth of the canyon. Practically no water now passes the station except the flood discharge and a small portion of the side drainage between the power company's dam and the gaging station, the greater part of the side drainage being diverted into the flume at various points along the line. The station is thus of little importance, but it is maintained at an extremely low cost, since the gage readings are made by the Telluride Power Company and the discharge curve is so well defined that but few more measurements are necessary.

The channel is straight for about 200 feet above and 100 feet below the station. The right bank is steep and rocky and does not overflow; the left is somewhat low and sloping and is liable to overflow at extreme flood stages. The bed of the stream is composed of bowlders and soil and is very rough, but permanent. The velocity is high, ranging from 4 to 6 feet per second. Ice forms near the banks and appears also as drift or floating ice. It is, however, limited in quantity and probably never piles up or gorges. There is no anchor or needle ice at any time.

Discharge measurements are made by means of a cable and car. The cable is marked at 3-foot intervals with white paint. The initial point for soundings is the first white mark on the cable south of the vertical post that supports the cable on the right bank. A guy line is stretched across the stream about 40 feet above the station and is found useful at all stages.

The original gage was of the inclined type and consisted of a piece of Oregon fir attached to vertical posts embedded in the left bank about 2 feet below the line of the cable. The present gage, daily readings of which are made under the direction of E. A. Brisco, an engineer at the power plant, is a vertical piece of aspen driven into the stream bed and supported at the top by a horizontal piece buried in the bank. It is located on the right bank about 30 feet above the line of the cable. Simultaneous readings on the two gages are found to be equal, but the zero of the new gage is 0.10 foot above that of the old one. The bench marks are as follows: (1) A cross chiseled in a limestone rock about 1 foot square, 100 feet S. 15° E. from the old gage; elevation above old gage datum, 6.98 feet. (2) A standard United States Geological Survey metallic plug, cemented in the top of the south abutment of the highway bridge about one-eighth mile below the station; elevation above zero of gage, 4.75 feet. (3) A cross chiseled on the top of a bowlder projecting 1 foot above the ground, 126 feet N. 75° W. from the north post supporting the cable; elevation above zero of gage, 11.21 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, p 123; 18, iv, pp 325–326; Bull 131, p 59; 140, p 234; WS 16, p 162; 28, p 146; 38, pp 338–339; 51, p 416; 66, p 123; 85, p 88; 100, pp 140–141, 142–143; 133, pp 261–262.

Discharge: Ann 18, iv, p 326; Bull 131, p 92; 140, p 234; WS 16, p 162; 28, p 153; 38, p 339; 51, p 416; 100, p 141; 66, p 123; 85, p 88; 100, p 143; 133, p 262.

Discharge, monthly: Ann 11, ii, p 104; 12, ii, pp 354, 361; 13, iii, p 97; 14, ii, pp 123–124; 18, iv, p 327; 19, iv, p 442; 20, iv, pp 458, 468; 21, iv, p 399; 22, iv, p 416; Bull 140, p 235; WS 75, p 195; 100, pp 142, 144; 133, p 264.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 61.

Gage heights: Bull 131, p 60; 140, p 234; WS 11, p 79; 16, p 162; 28, p 152; 38, p 339; 51, p 417; 66, p 124; 100, p 141, 143–144; 133, p 263.

Hydrographs: Ann 12, ii, p 340; 14, ii, p 125; 18, iv, p 328; 19, iv, p 442; 20, iv, p 468; 21, iv, p 399; 22, iv, p 417.

Rainfall and run-off relation: Ann 20, iv, p 459.

Rating tables: Ann 18, iv, p 326; 19, iv, p 441; Bull 131, p 59; 140, p 234; WS 28, p 154; 39, p 456; 52, p 521; 66, p 176; 100, pp 142, 144; 133, p 263.

Water powers: Ann 19, iv, p 441.

Discharge measurements of Provo River at mouth of canyon, near Provo, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 4	Henry Kleinschmidt	73	116	2.58	4.50	30[illegible]
May 24	W. G. Swendsen	75	138	3.52	4.95	4[illegible]
August 29 [a]	A. B. Larson	32	41	.62	3.55	2[illegible]

[a] Measurement made 100 feet above regular station.

Daily gage height, in feet, of Provo River at mouth of canyon, near Provo, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	4.21	4.51	4.4	4.78	5.39	4.05	3.65	3.58	3.66	3.51	3.8[illegible]
2	3.98	4.42	4.56	4.34	4.8	5.63	3.93	3.54	3.5	3.75	3.56	3.8[illegible]
3	4.12	4.6	4.58	4.37	4.77	5.7	3.87	3.69	3.44	3.76	3.59	3.68
4	4.3	4.52	4.65	4.32	4.72	5.95	3.95	3.52	3.57	3.68	3.52	3.8
5	4.22	4.51	4.46	4.3	4.5	5.87	3.83	3.61	3.67	3.68	3.56	3.62
6	4.14	4.52	4.66	4.3	4.34	5.77	4.0	3.55	3.7	3.71	3.56	3.77
7	4.2	4.21	4.18	4.35	4.22	5.65	3.95	3.53	3.6	3.71	3.52	3.8
8	4.4	4.28	4.0	4.34	4.4	5.86	3.93	3.56	3.58	3.66	3.55	3.68
9	4.1	4.11	3.98	4.24	4.47	6.33	3.83	3.5	3.63	3.69	3.55	3.49
10	4.1	4.14	3.91	4.6	4.5	5.97	3.65	3.51	3.64	3.7	4.04	3.45
11	4.1	4.08	3.88	4.68	4.49	5.65	3.63	3.55	3.48	3.61	3.92	3.45
12	4.38	4.08	4.2	4.35	4.28	5.19	3.6	3.55	.....	3.63	4.05	3.48
13	4.1	4.01	4.14	4.25	4.3	5.75	3.6	3.53	.....	3.6	4.03	3.51
14	4.12	4.0	4.0	4.4	4.28	5.75	3.7	3.49	.....	3.62	3.96	3.47
15	4.05	4.05	4.3	4.44	4.29	5.53	3.67	3.52	.....	3.64	3.98	3.68
16	4.07	4.09	4.52	4.45	4.4	5.5	3.63	3.57	.....	3.63	4.0	3.6
17	3.79	4.2	4.5	4.52	4.45	5.23	3.6	3.5	.....	3.59	3.99	3.62
18	3.78	4.1	4.4	4.52	4.43	5.0	3.63	3.45	.....	3.64	3.89	3.62
19	4.02	4.12	4.5	4.51	4.76	4.87	3.65	3.63	.....	3.65	3.91	.....
20	4.1	4.15	4.57	4.51	4.77	4.78	3.62	3.61	.....	3.58	3.76	.....
21	3.56	4.14	4.18	4.56	4.89	4.71	3.5	3.53	.....	3.61	3.89	.....
22	4.04	4.11	4.45	4.5	5.06	4.77	3.5	3.46	.....	3.63	3.82	.....
23	4.14	4.15	4.43	.....	5.1	4.85	3.5	3.55	.....	3.57	3.88	.....
24	4.13	4.25	4.49	4.4	5.09	4.7	3.55	3.68	.....	3.57	3.8	.....
25	4.05	4.22	4.43	4.45	5.0	4.43	3.6	3.59	3.51	3.55	3.74	.....
26	4.08	4.21	4.43	4.75	5.02	4.17	3.6	3.59	3.52	3.6	3.93	.....
27	4.06	4.42	4.49	4.94	5.1	4.2	3.58	3.56	3.49	3.61	3.9	.....
28	4.03	4.5	4.48	4.84	5.2	4.15	3.57	3.57	3.55	3.59	3.95	.....
29	4.03	.....	4.43	4.72	5.22	4.05	3.6	.....	3.85	3.58	3.95	.....
30	4.08	.....	4.43	4.78	5.15	3.93	3.6	.....	3.78	3.65	3.91	.....
31	4.13	.....	4.34	.....	5.1	.....	.....	.....	.....	3.64	.....	.....

Station rating table for Provo River at mouth of canyon, near Provo, Utah, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	12	4.20	177	5.00	532	5.80	1,050
3.50	20	4.30	212	5.10	589	5.90	1,120
3.60	31	4.40	250	5.20	649	6.00	1,192
3.70	46	4.50	290	5.30	711	6.10	1,265
3.80	64	4.60	332	5.40	775	6.20	1,340
3.90	87	4.70	377	5.50	841	6.30	1,415
4.00	114	4.80	425	5.60	910	6.40	1,490
4.10	144	4.90	477	5.70	980		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 3.5 feet and 6.3 feet.

Daily discharge, in second-feet, of Telluride Power Company's flume near Provo, Utah, for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	24	52	40	40	45	79	163	130	136	173
2	29	40	62	35	62	88	141	130	124	184
3	23	41	78	40	70	85	117	130	125	170
4	29	38	77	29	68	82	126	145	124	178
5	36	36	49	24	75	74	148	150	127	183
6	41	36	57	59	61	106	131	130	130	175
7	43	34	66	41	62	80	139	127	130	163
8	33	45	68	24	59	75	142	130	127	155
9	37	55	63	70	75	80	137	135	129	167
10	44	50	49	39	96	69	137	127	162	169
11	46	26	59	32	95	52	133	130	170	170
12	27	78	65	39	99	87	136	130	160	150
13	38	60	66	53	101	80	.....	.....	160	171
14	25	51	62	48	90	88	.....	.....	155	168
15	43	55	54	50	98	85	.....	130	153	188
16	49	55	43	42	97	85	.....	131	160	185
17	41	48	59	58	100	79	.....	128	160	183
18	56	36	70	48	94	89	.....	126	160	187
19	62	83	45	42	92	105	.....	129	161	.....
20	41	66	55	48	85	124	.....	135	.....	.....
21	56	60	38	45	87	130	.....	126	.....	.....
22	62	65	40	41	87	131	.....	158	.....	.....
23	49	.....	50	42	87	117	.....	150	.....	.....
24	47	85	44	37	84	123	.....	158	.....	.....
25	38	75	48	68	81	114	133	161	.....	.....
26	40	.....	36	81	80	150	124	141	.....	.....
27	39	.....	65	45	80	146	122	135	.....	.....
28	32	50	48	47	80	121	119	142	.....	.....
29	44	37	32	40	77	.....	157	.....	.....	.....
30	53	33	44	64	78	.....	137	.....	.....	.....
31	54	.....	30	.....	.....	.....	.....	160	.....	.....

Estimated monthly discharge of Provo River at mouth of canyon, near Provo, Utah, for 1905.

[Drainage area, 640 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	250	27	142	8,731	0.222	0.256
February	332	114	190	10,550	.297	.309
March	359	82	239	14,700	.373	.430
April	499	191	288	17,140	.450	.502
May	661	184	396	24,350	.619	.714
June	1,438	95	687	40,880	1.07	1.19
July	129	20	50.1	3,080	.078	.090
August	44	16	26.8	1,648	.042	.048
September (17 days)	76	15	32.6	1,099	.051	.032
October	56	26	37.1	2,281	.058	.067
November	129	21	73.0	4,344	.114	.127
December 1-18	66	16	38.3	1,368	.060	.040
The period				130,200		

Estimated monthly discharge of Telluride Power Company's flume near Provo, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	62	23	41.3	2,539
April (27 days)	85	26	51.5	2,758
May	78	30	53.6	3,296
June	81	24	45.7	2,719
July 1-30	101	45	81.5	4,850
August 1-28	150	52	97.3	5,404
September 1-12, 25-30	163	117	136	4,856
October (27 days)	161	126	137	7,337
November 1-19	170	124	140	5,276
December 1-18	188	150	173	6,176
The period				45,210

NOTE.—To obtain total flow of Provo River at head of diversion dams, the flume discharge should be added to that of the gaging station given above.

PROVO RIVER AT THE RIO GRANDE WESTERN RAILWAY BRIGDE, NEAR PROVO, UTAH.

This station was established January 25, 1905. It is located at the Rio Grande Western Railway bridge about 2 miles northwest of the town of Provo, below all points of diversion and inflowing streams. It replaces the old station maintained at the San Pedro Los Angeles, and Salt Lake Railroad bridge, about 300 feet below, the conditions at the latter point being so changed by the reconstruction of the bridge that the section could no longer be used.

The purpose of the station is to determine the amount of water discharged by the Provo into Utah Lake. As the entire normal spring and summer flow is diverted for irrigation above this point, the station is maintained only during flood and winter seasons.

The channel is straight for about 150 feet above and 200 feet below the station. The normal flow is confined to a comparatively narrow channel near the center, but the high-

water channel is much wider, including a small timbered flat on both sides. The railroad grade, however, prevents any overflow at the gaging section. The bed of the stream is composed of coarse gravel and is liable to change during floods. The velocity is uniform but high, ranging from 4 to 7 feet. Information in regard to ice conditions is incomplete.

Discharge measurements are made from a foot plank, fastened to 4 by 4 inch pieces of fir bolted to the lower chord on the upstream side of the bridge. The plank is graduated with paint, beginning at the north face of the masonry abutment on the south end of the bridge, which is the initial point for soundings. A guy line is stretched 24 feet upstream from the foot plank.

The gage, which is read daily by Lars Thompson, a farmer, is of the inclined type, consisting of a 4 by 4 inch by 16-foot timber of Oregon fir drift-bolted to the old piles and sills of the former bridge, about 10 feet east of the present bridge, the incline being such that 15.88 feet along the piece equal 10 feet vertical. It is graduated with saw cuts and paint to read vertically. The gage is referred to bench marks as follows: (1) A standard United States Geological Survey metallic plug, cemented in the masonry wall, 0.5 foot south of its face at the southeast corner of the bridge; this is 11.29 feet above the gage datum and is so stamped. (2) A cross cut in the top of the same wall at the southwest corner of the bridge; elevation above gage datum, 11.25 feet.

Discharge measurements of Provo River at the Rio Grande Western Railway bridge, near Provo, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 25	H. S. Kleinschmidt	44	54	3.52	2.80	191
February 14 [a]	do	37	38	3.12	2.53	120
February 16	do	43	49	3.49	2.74	170
March 9	do	43	49	3.36	2.70	166
June 21	W. G. Swendsen	17	8.5	1.52	2.00	12.9

[a] Ice divides stream into two channels.

Daily gage height, in feet, of Provo River at the Rio Grande Western Railway Bridge, near Provo, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	.....	2.85	2.75	2.6	2.7	2.55	17	.....	2.75	2.65	2.75	2.0	3.05
2	.....	3.1	2.75	2.55	2.8	3.05	18	.....	2.7	2.65	2.7	2.0	2.8
3	.....	3.15	2.8	2.52	2.8	3.5	19	.....	2.7	2.7	2.6	2.0	2.47
4	.....	3.0	2.9	2.53	2.7	3.7	20	.....	2.7	2.85	2.7	2.25	2.18
5	.....	2.95	3.0	2.5	2.6	3.75	21	.....	2.7	2.75	2.75	2.1	2.0
6	.....	2.9	3.0	2.5	2.4	3.6	22	.....	2.7	2.75	2.9	2.15	Dry.
7	.....	2.85	2.9	2.47	2.25	3.54	23	.....	2.7	2.7	2.9	2.6	.....
8	.....	2.8	2.8	2.45	2.2	3.65	24	.....	2.7	2.65	2.9	2.62	.....
9	.....	2.85	2.7	2.6	2.2	4.27	25	.....	2.7	2.65	2.85	2.58	.....
10	.....	2.85	2.7	2.75	2.4	4.2	26	2.8	2.68	2.65	2.75	2.62	.....
11	.....	2.85	2.7	2.85	2.3	3.73	27	2.8	2.65	2.8	2.85	2.68	.....
12	.....	2.8	2.7	2.8	2.15	3.55	28	2.8	2.65	2.7	2.9	2.75	.....
13	.....	2.6	2.67	2.8	2.05	3.53	29	2.8	.....	2.65	2.75	2.8	.....
14	.....	2.55	2.7	2.75	2.1	3.45	30	2.8	.....	2.7	2.7	2.65	.....
15	.....	2.7	2.7	2.7	2.0	3.43	31	2.8	.....	2.65	.....	2.55	.....
16	.....	2.8	2.65	2.7	2.25	3.25							

NOTE.—Station discontinued June 22.

HOBBLE CREEK BASIN.

HOBBLE CREEK NEAR SPRINGVILLE, UTAH.

Hobble Creek rises on the western slope of the Wasatch Mountains and flows in a general southwesterly direction to Utah Lake. There is little overlying soil and but a scanty growth of timber or brush. The steep, narrow canyon in which the stream flows is broken here and there by narrow openings or flats, covered with a shallow deposit of bowlders and soil and comprising irrigated farms. As these tracts lie along the banks of the creek, a large part of the water used on them is returned to the stream as seepage. There are no tributaries of importance, but short, intermittent streams, each of which is confined to a steep, narrow canyon, enter all along the course. There are no storage reservoirs, lakes, or marshes to control the flood discharge, which occurs in the spring as the result of melting snow. The entire normal summer flow is used for irrigation, but the diversion takes place for the most part at the mouth of the canyon below the gaging station.

The station was established March 23, 1904. It is located about 1 mile above the mouth of the canyon, 4 miles southeast of Springville, Utah, 600 feet northeast of the head of Mapleton Canal, and about 1,200 feet southwest of the Springville electric power plant.

The channel is straight for about 75 feet above and 50 feet below the station. Both banks are high and wooded. The bed of the stream is of loose, fine gravel, and shifts almost constantly. There is but one channel at all stages. The velocity ranges from 3 to 4.5 feet per second. As the normal winter flow comes largely from springs, the stream probably does not freeze at the station.

Discharge measurements are made by wading at a point near the gage. The initial point for soundings is a 2 by 4 inch post located on the south bank near the water's edge.

The gage, which is read daily by J. B. Stevenson, an electrician, is a vertical staff, driven into the bed of the stream and fastened at the top to an overhanging tree. The gage is referred to bench marks as follows: (1) A nail in the top of the 2 by 4 inch post used as the initial point for soundings; elevation above gage datum, 4.91 feet. (2) A nail in a post set 26 feet south of the initial point; elevation above gage datum, 12.38 feet. (3) A 30-penny nail in the east side of a pole of the electric transmission line, 97 feet northwest of the initial point; elevation, 21.80 feet above gage datum.

A description of this station, gage height and discharge data, and rating table are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 268–270.

Discharge measurements of Hobble Creek near Springville, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
February 16	H. S. Kleinschmidt	14	12	1.62	1.25	20
April 5	W. G. Swendsen	18	11	2.57	1.42	28
May 5	W. P. Hardesty	18	18	3.22	1.80	58
May 23	W. G. Swendsen	19	29	3.92	2.30	112
June 6	A. B. Larson	18	17	3.84	1.75	64
June 11	do	18	21	3.72	1.80	76
June 26	do	18	16	2.82	1.55	44
July 11	G. M. P. Dougall	18	9.2	2.35	1.30	22
July 17	do	18	9.8	2.30	1.30	23
July 29	G. S. Schow	18	8.7	2.21	1.16	19
August 9	do	18	9.5	2.15	1.25	20
August 16	do	17	9.6	1.84	1.24	17.7
August 30	A. B. Larson	17	9.7	1.48	1.21	14.4
September 16	G. S. Schow	17	8.7	1.65	1.20	14.5
September 28	A. B. Larson	17	8.3	1.60	1.19	13.0
October 12	W. D. Beers	16	7.8	1.61	1.20	12.6

Daily gage height, in feet, of Hobble Creek near Springville, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.38	1.35	1.4	2.1	1.75	1.35	1.15	1.25	1.2	1.23	1.25
2	.....	1.4	1.35	.....	2.05	1.8	1.35	1.2	1.25	1.2	1.25	1.22
3	.....	1.4	1.35	1.4	1.95	.....	1.3	1.3	1.25	1.18	1.22	1.2
4	.....	1.4	1.35	.....	1.85	1.8	1.35	1.35	1.2	1.15	1.25	1.2
5	1.3	1.4	1.4	.....	1.8	1.85	1.3	.....	1.2	1.12	1.25	1.2
6	.....	1.4	1.4	1.45	1.75	1.8	1.26	1.2	1.2	1.12	1.22	1.18
7	.....	1.38	1.4	.....	1.7	1.8	1.24	1.25	1.25	1.1	1.23	1.2
8	.....	1.38	1.4	1.5	1.75	2.0	1.25	1.2	1.3	1.1	1.25	1.2
9	.....	1.38	1.4	1.5	1.75	1.92	1.25	.....	1.3	1.12	1.28	1.2
10	.....	1.38	.....	1.8	1.75	1.8	1.25	1.22	1.25	1.13	1.3	1.1
11	.....	.....	1.4	1.6	1.8	1.75	1.25	1.2	1.25	1.15	1.27	1.17
12	.....	.....	.....	1.6	1.8	1.75	1.25	1.2	1.25	1.17	.....	1.15
13	1.3	.....	1.4	1.6	1.9	1.75	1.25	1.15	1.25	1.2	1.2	1.15
14	.....	.....	1.4	.....	1.95	1.85	1.25	1.2	1.25	1.18	1.22	1.18
15	.....	1.38	1.4	1.6	2.05	1.8	1.3	1.25	1.25	1.17	1.23	1.2
16	.....	1.35	1.4	1.7	2.1	1.7	1.3	1.2	1.25	1.2	1.22	1.25
17	1.3	.....	1.4	1.6	2.3	1.6	1.3	1.2	1.25	1.2	1.23	1.22
18	.....	1.35	1.4	.....	2.35	1.6	1.3	1.14	1.25	1.2	1.2	1.25
19	1.3	.....	1.4	1.7	2.4	1.65	1.3	1.12	1.22	1.18	1.18	1.25
20	.....	1.35	1.45	.....	2.35	1.6	1.25	1.2	1.2	1.17	1.2	1.23
21	.....	1.35	1.4	1.62	2.4	1.53	1.3	1.15	1.2	1.2	1.2	1.22
22	.....	1.35	1.4	1.65	2.45	1.5	1.3	1.12	1.25	1.2	1.25	.....
23	1.35	1.35	1.4	1.7	2.4	1.55	1.25	1.16	1.2	1.2	1.22	.....
24	.....	1.35	1.4	1.7	2.25	1.5	1.2	2.06	1.2	1.2	1.23	.....
25	1.35	1.35	1.35	1.7	2.2	1.5	1.8	1.25	1.2	1.2	1.2	1.15
26	.....	1.35	1.35	1.85	2.1	1.55	1.2	1.27	1.2	1.18	1.2	1.15
27	1.33	1.35	1.45	1.95	2.0	1.5	1.2	1.25	1.2	1.18	1.25	1.25
28	.....	1.35	1.4	2.0	1.9	1.45	1.15	1.25	1.2	1.17	1.25	1.22
29	.....	.....	1.4	2.0	1.7	1.42	1.15	1.3	1.35	1.2	1.25	.....
30	1.33	.....	1.4	.....	1.7	1.4	1.15	1.2	1.2	1.2	1.25	1.23
31	1.35	.....	1.35	.....	1.7	.....	1.2	1.2	.....	1.22	.....	.....

Station rating table for Hobble Creek near Springville, Utah, from January 1, to May 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	22.0	1.60	40.5	1.90	68	2.20	100
1.40	27.5	1.70	48.5	2.00	78	2.30	112
1.50	33.5	1.80	58	2.10	89	2.40	125

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. It is fairly well defined.

Station rating table for Hobble Creek near Springville, Utah, from May 31, to December 31, 1905.

Gage height.	Discharge	Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	7.0	1.40	30.5	1.70	61	2.00	99
1.20	14.5	1.50	40	1.80	73	2.10	113
1.30	22.0	1.60	50	1.90	86		

NOTE.—The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 1.8 feet.

Estimated monthly discharge of Hobble Creek near Springville, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	24	22	22.8	1,4[illegible]
February	28	24	25.6	1,4[illegible]
March	30	24	27.0	1,6[illegible]
April	78	28	45.2	2,6[illegible]
May	132	48	81.0	4,9[illegible]
June	99	30	59.4	3,5[illegible]
July	26	11	18.6	1,144
August	107	8	18.3	1,[illegible]
September	26	14	17.1	1,018
October	16	7	12.5	7[illegible]
November	22	13	16.9	1,0[illegible]
December	18	7	14.6	[illegible]
The year	132	7	29.9	21,650

NOTE.—Open-channel conditions assumed throughout the year. Discharge interpolated for missing gage heights.

SPANISH FORK BASIN.

SPANISH FORK NEAR SPANISH FORK, UTAH.

Spanish fork rises in the Wasatch Mountains and flows northwestward into Utah Lake. The area is generally barren, with but little timber or brush. The stream is confined to a steep, narrow canyon, with a very few small openings in which are irrigated farms. The tributaries are all short and many of them are intermittent. The most important are Diamond Fork and Thistle Creek, which enter about 8 and 10 miles, respectively, above the gaging station, and which, like the main stream, occupy steep narrow canyons. The normal flow comes largely from springs, scattered over the entire basin; the flood discharge is direct surface run-off from melting snow.

There are no storage reservoirs on the stream and but little of the flow is diverted above the station. The entire normal flow is, however, diverted at the mouth of the canyon, immediately below the station, and used for the irrigation of lands near Utah Lake.

The station was established May 23, 1900, and reestablished March 26, 1903. It is located 600 feet above the dam of the East Bench Irrigation Company, 5 miles southeast of Spanish Fork, and 300 feet southwest of the main line of the Rio Grande Western Railway.

Records at this station are of importance in connection with the Strawberry Valley storage reservoir project, under a plan to divert water from that basin into Spanish Fork near its head and carry it to distribution canals below.

The channel is straight for about 150 feet above and below the station. Both banks slope gradually, are covered with small brush, and are sufficiently high to prevent overflow. The bed is composed of loose gravel and sand, and is smooth but somewhat shifting, especially at flood stages. The velocity is high. There is a free flow, the current being uninterrupted by dams or other obstructions.

Discharge measurements are made by means of a cable and car. The cable is graduated with paint, beginning at the right cable post, which is the initial point for soundings.

The gage, which is read daily by Levi Thorp, a section foreman on the Rio Grande Western Railway, consisted originally of a vertical staff located on the right bank of the stream. In April, 1905, it was replaced by a new 6 by 6 inch inclined gage having the same datum. The bench mark is on a limestone rock 29 feet S. 36° E. from the gage, marked with black paint "U. S. G. S."; elevation above gage datum, 7.16 feet; elevation above mean sea level, 4,785 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann.=Annual Report; WS=Water-Supply Paper):

Description: WS 100, p 145; 133, p 271.
Discharge: WS 100, p 145; 133, p 271.
Discharge, monthly: Ann 13, iii, p 97; WS 100, p 147; 133, p 273.
Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 61.
Gage heights: WS 100, p 146; 133, p 272.
Rating table: WS 100, pp 146-147; 133, pp 272-273.

Discharge measurements of Spanish Fork near Spanish Fork, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 27	H. S. Kleinschmidt	37	30	2.68	1.42	79
February 15	do	35	28	2.66	1.38	74
March 10	do	37	29	2.51	1.40	72
April 19	W. G. Swendsen	39	39	3.17	1.70	111
May 11	W. P. Hardesty	36	44	3.50	1.90	154
May 15	W. G. Swendsen	37	49	4.04	2.00	200
May 22	do	40	85	4.34	2.32	369
May 22	do	40	85	4.42	2.82	376
May 22	do	40	85	4.00	2.82	360
June 3	A. B. Larson	38	68	4.59	2.45	314
June 9	do	37	49	3.99	2.04	195
June 26	do	35	30	2.85	1.60	86
July 31	Beers and Schow	34	25	2.19	1.40	54
August 9	G. S. Schow	40	21	1.99	1.32	43
August 30	A. B. Larson	34	20	2.60	1.41	52
September 7	G. S. Schow	35	25	2.56	1.47	64
September 10	do	34	20	2.39	1.38	49
September 28	A. B. Larson	34	22	2.35	1.41	52
October 12	W. D. Beers	33	24	2.46	1.48	59

Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.46	1.6	1.5	2.06	2.56	1.52	1.36	1.36	1.64	1.48	1.46
2	1.26	1.56	1.56	1.48	2.04	2.52	1.5	1.34	1.36	1.56	1.48	1.44
3	1.5	1.5	1.62	1.48	2.02	2.48	1.5	1.4	1.36	1.44	1.48	1.4
4	1.32	1.5	1.54	1.46	1.96	2.38	1.46	1.36	1.61	1.44	1.48	1.44
5	1.4	1.5	1.5	1.48	1.92	2.26	1.44	1.36	1.42	1.42	1.48	1.5
6	1.56	4.48	1.5	1.48	1.82	2.24	1.46	1.36	1.4	1.44	1.48	1.4
7	1.4	1.46	1.48	1.5	1.82	2.14	1.46	1.3	1.44	1.45	1.48	1.44
8	1.4	1.46	1.48	1.52	1.84	2.1	1.46	1.3	1.42	1.42	1.48	1.44
9	1.4	1.4	1.46	1.54	1.98	2.02	1.4	1.3	1.4	1.42	1.48	1.44
10	1.42	1.42	1.46	1.76	1.96	2.02	1.42	1.36	1.4	1.48	1.48	1.4
11	1.44	1.44	1.46	1.7	1.9	2.0	1.42	1.5	1.4	1.48	1.48	1.3
12	1.4	1.26	1.44	1.7	1.84	1.96	1.4	1.4	1.4	1.48	1.48	1.24
13	1.38	1.6	1.46	1.66	2.0	1.88	1.38	1.38	1.4	1.46	1.4	1.25
14	1.42	1.4	1.48	1.64	2.0	1.82	1.4	1.38	1.4	1.46	1.44	1.4
15	1.42	1.4	1.48	1.62	2.0	1.76	1.4	1.36	1.4	1.48	1.44	1.3
16	1.44	1.34	1.44	1.7	2.04	1.76	1.4	1.34	1.4	1.48	1.44	1.25
17	1.42	1.44	1.46	1.7	2.22	1.74	1.4	1.34	1.34	1.48	1.46	1.3
18	1.42	1.42	1.46	1.66	2.41	1.76	1.38	1.34	1.34	1.46	1.46	1.3
19	1.34	1.4	1.5	1.74	2.54	1.78	1.38	1.32	1.38	1.44	1.46	1.3
20	1.44	1.44	1.6	1.72	2.64	1.78	1.36	1.32	1.38	1.44	1.44	1.3

Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1905—Continued

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov	Dec
21	1.44	1.48	1.6	1.72	2.74	1.78	1.34	1.32	1.36	1.44	1.44	[illegible]
22	1.44	1.48	1.52	1.7	2.84	1.74	1.36	1.3	1.36	1.48	1.5	[illegible]
23	1.46	1.46	1.5	1.74	2.94	1.72	1.34	1.3	1.36	1.48	1.5	[illegible]
24	1.44	1.48	1.5	1.76	2.84	1.66	1.34	1.32	1.34	1.48	1.5	[illegible]
25	1.46	1.48	1.5	1.78	2.74	1.6	1.34	1.66	1.44	1.48	1.46	[illegible]
26	1.42	1.48	1.48	1.86	2.8	1.6	1.34	1.42	1.48	1.48	1.46	[illegible]
27	1.36	1.46	1.5	1.92	2.74	1.58	1.34	1.46	1.5	1.48	1.5	[illegible]
28	1.38	1.5	1.5	1.98	2.78	1.58	1.34	1.48	1.46	1.48	1.46	[illegible]
29	1.44	.....	1.52	1.97	2.7	1.56	1.34	1.4	2.22	1.48	1.46	[illegible]
30	1.46	.....	1.54	2.0	2.6	1.54	1.34	1.38	1.64	1.48	1.46	[illegible]
31	1.44	.....	1.46	.....	2.56	.....	1.34	1.34	.....	1.5	.....	[illegible]

NOTE.—January 3 and 6 and February 13, backwater caused by ice; open-channel conditions during the remainder of the winter months. Gage February 6 probably in error.

Daily discharge, in second-feet, of Spanish Fork near Spanish Fork, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	57	86	112	79	192	336	56	48	45	92	60	[illegible]
2	39	106	104	76	187	329	54	46	45	76	60	[illegible]
3	43	95	115	75	182	322	54	54	45	54	61	[illegible]
4	47	95	100	71	168	292	48	48	89	54	61	[illegible]
5	57	95	92	74	158	258	47	48	53	50	61	[illegible]
6	59	91	92	74	136	252	49	48	50	53	62	[illegible]
7	60	87	88	77	136	224	50	42	59	50	62	[illegible]
8	61	87	88	81	140	212	51	42	53	50	62	[illegible]
9	62	75	84	83	172	190	43	42	52	50	62	[illegible]
10	66	79	83	127	168	188	46	46	52	60	62	[illegible]
11	70	83	82	114	154	180	47	68	52	60	63	[illegible]
12	64	52	78	113	145	168	44	52	52	59	63	[illegible]
13	60	64	81	109	189	147	43	49	52	55	50	[illegible]
14	69	76	85	100	195	132	46	49	52	55	56	[illegible]
15	69	77	84	96	200	118	46	46	52	59	56	[illegible]
16	74	65	76	112	203	116	46	44	52	59	56	[illegible]
17	71	74	80	112	242	110	47	44	44	59	59	[illegible]
18	72	71	79	102	286	112	44	44	44	56	59	[illegible]
19	58	76	86	119	315	115	45	41	48	54	59	[illegible]
20	77	83	105	114	335	113	43	41	48	54	57	[illegible]
21	78	91	105	114	355	111	42	41	45	54	57	[illegible]
22	79	91	89	111	375	102	43	38	45	59	67	[illegible]
23	81	85	84	119	410	96	42	38	45	59	67	[illegible]
24	80	89	84	122	384	81	42	41	43	59	67	[illegible]
25	83	89	83	127	360	68	43	95	55	59	60	[illegible]
26	76	89	79	144	382	67	43	53	62	60	60	[illegible]
27	67	85	82	158	368	64	44	58	66	60	68	[illegible]
28	70	94	82	172	383	65	44	62	58	60	61	[illegible]
29	82	.....	85	170	364	62	45	50	228	60	61	[illegible]
30	85	.....	88	178	340	58	45	47	92	60	61	[illegible]
31	82	.....	72	.....	331	.....	46	43	.....	65	.....	[illegible]

NOTE.—Daily discharge obtained by indirect method for shifting channels. Discharge January 3 and 6 and February 13 reduced on account of backwater from ice. Discharge February 6 interpolated between February 5 and 7 on assumption that gage height of February 6 was in error.

Estimated monthly discharge of Spanish Fork River near Spanish Fork, Utah, for 1905.

[Drainage area, 670 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	85	39	67.7	4,163	0.101	0.116
February	106	52	83.2	4,621	.124	.129
March	115	72	88	5,411	.131	.151
April	178	71	111	6,605	.166	.185
May	410	136	257	15,800	.384	.443
June	336	58	156	9,283	.233	.260
July	56	42	46.1	2,835	.069	.080
August	95	38	48.6	2,988	.073	.084
September	228	43	59.3	3,529	.089	.099
October	92	50	58.5	3,597	.087	.100
November	68	50	60.7	3,612	.091	.102
December	114	35	54.7	3,363	.082	.094
The year	410	35	90.9	65,810	.136	1.84

SPANISH FORK NEAR LAKE SHORE, UTAH.

This station was established December 10, 1903, at the highway bridge on the road between Spanish Fork and Lake Shore, about 3 miles west of Spanish Fork. In May, 1904, it was reestablished at a point about 800 feet above the bridge.

As the entire normal summer flow is diverted at a point above, the station is maintained only during the spring and winter, the object being the determination of the amount of water discharged by Spanish Fork into Utah Lake.

The channel is straight for about 75 feet above and is slightly curved for 100 feet below the station. Both banks are barren and sufficiently high to prevent overflow. The bed at this point is composed of fine gravel and sand, smooth but continually shifting. The velocity ranges from 2 to 4 feet per second, and the depth from 1 foot to 3 feet. Information in regard to winter conditions are incomplete.

Discharge measurements are made from a cable and car. The cable is marked at 4-foot intervals, beginning at the right cable post, which is the initial point for soundings.

Daily gage readings are made by J. W. Bowen, a farmer. The original gage was a vertical staff driven into the bed of the stream about 10 feet below the bridge. This was abandoned at the beginning of 1905, and readings have since been taken from the new vertical gage located on the right bank near the cable. It consists of a 2 by 4 inch fir post, driven into the bed of the stream and supported at the top by a horizontal piece buried in the bank. The datum is the same as that of the old gage, but simultaneous readings will not agree, as there is considerable fall to the stream between the two gages. The gage is referred to bench marks as follows: (1) A 30-penny nail driven into a log on the west abutment of the bridge, near the northwest corner, 10.5 feet S. 18° 30′ W., from the old gage; elevation above gage datum, 11.68 feet. (2) A 20-penny nail driven into the north side of a cedar fence post, 91 feet, S. 85° 30′ E., from the gage; elevation above gage datum, 21.95 feet. (3) A United States Geological Survey standard metallic post set 197 feet S. 21° 45′ E. from the old gage; elevation above gage datum, 21.76 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 133, p 274.
Discharge: 100, p. 224: 133, p. 275.
Discharge, monthly: 133, p. 276.
Gage heights: 133, p 275.
Rating table: 133, p 276.

Discharge measurements of Spanish Fork near Lake Shore, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 27	H. S. Kleinschmidt	30	26	2.57	4.61	66
February 15	do	26	21	2.31	4.37	49
March 10	do	28	18	2.27	4.12	42
April 6	W. G. Swendsen	28	23	2.41	4.35	66
April 20	do	32	36	2.67	4.78	98
May 4 [a]	W. P. Hardesty	6	6.7	2.84	3.85	19
May 22	W. G. Swendsen	24	15	2.55	4.05	38
December 4	do	28	18	2.16	4.12	38

[a] 30 feet below regular station.

Daily gage height, in feet, of Spanish Fork near Lake Shore, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Nov.	Dec.	Day.	Jan.	Feb.	Mar.	Apr.	May.	Nov.	Dec.
1	4.6	4.67	4.52	4.5	4.75	.....	4.0	17	4.62	4.6	4.08	4.9	3.4	.....	4.3
2	4.1	4.97	4.58	4.35	4.3	.....	4.2	18	4.6	4.6	4.1	5.0	4.0	.....	4.3
3	4.2	4.85	4.52	4.33	4.2	.....	4.2	19	4.5	4.59	4.15	4.9	4.02	.....	4.1
4	4.2	4.8	4.5	4.3	3.85	.....	4.2	20	4.6	4.58	4.3	4.85	3.7	.....	4.1
5	4.1	4.73	4.55	4.31	3.6	.....	4.18	21	4.6	4.6	4.25	4.72	3.7	.....	4.1
6	4.4	4.7	4.53	4.35	3.48	.....	4.1	22	4.63	4.61	4.3	4.71	3.9	.....	4.1
7	4.2	4.68	3.9	4.48	3.43	.....	4.05	23	4.7	4.55	4.3	4.63	4.3	.....	4.2
8	4.45	4.61	4.1	4.58	3.42	.....	4.0	24	4.63	4.55	4.2	4.73	4.03	.....	4.2
9	4.45	4.5	4.11	4.68	3.43	.....	.....	25	4.62	4.55	4.2	4.65	3.5	.....	4.2
10	4.2	4.58	4.15	5.1	3.4	.....	4.0	26	4.61	4.58	4.0	4.68	3.55	.....	4.3
11	4.62	4.6	4.05	4.98	3.42	.....	4.1	27	4.6	4.58	4.15	4.79	3.5	.....	4.3
12	4.7	4.2	4.1	4.88	3.43	.....	4.2	28	4.59	4.51	4.1	4.82	3.53	.....	4.2
13	4.6	4.1	4.12	4.8	3.4	.....	4.2	29	4.58	.....	4.1	4.8	3.4	.....	4.3
14	4.8	4.39	4.2	4.85	3.38	.....	4.3	30	4.6	.....	4.12	4.72	3.0	4.0	4.25
15	4.6	4.38	4.15	4.88	3.38	.....	4.3	31	4.61	.....	4.11	.....	3.0	.....	.....
16	4.6	4.52	4.1	4.9	3.38	.....	4.1								

Daily discharge, in second-feet, of Spanish Fork near Lake Shore, Utah., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Nov.	Dec.	Day.	Jan.	Feb.	Mar.	Apr.	May.	Nov.	Dec.
1	53.0	71.0	67.0	77.0	83.0	.....	31.5	17	62.0	67.0	41.5	108.0	7.5	.....	51.5
2	22.5	95.5	71.5	65.0	46.0	.....	44.5	18	61.0	67.5	43.0	116.0	33.5	.....	51.5
3	28.0	85.5	68.0	63.5	38.2	.....	44.5	19	53.0	67.0	46.5	106.0	35.0	.....	39.0
4	29.5	81.2	67.0	61.0	19.0	.....	38.5	20	61.0	67.0	58.0	96.0	18.5	.....	38.0
5	23.0	76.0	72.0	62.5	10.3	.....	43.5	21	62.0	69.0	54.0	89.5	19.3	.....	38.0
6	41.0	73.0	71.5	66.0	7.0	.....	38.0	22	65.0	70.5	58.0	88.0	28.5	.....	38.0
7	29.5	72.2	27.5	76.0	6.5	.....	34.7	23	71.0	66.0	58.0	80.0	54.5	.....	44.5
8	45.5	66.0	39.0	83.5	6.0	.....	32.0	24	65.5	66.5	51.0	88.0	36.5	.....	44.5
9	46.0	58.0	41.5	92.0	6.5	.....	32.0	25	64.5	67.5	51.5	80.5	11.2	.....	44.5
10	30.0	64.5	42.0	129.0	6.0	.....	32.0	26	65.0	70.5	38.0	82.0	13.0	.....	51.5
11	58.5	66.0	37.5	117.5	6.5	.....	38.0	27	66.0	71.5	48.0	90.0	11.0	.....	51.5
12	66.0	36.0	41.0	108.0	7.0	.....	44.5	28	64.5	65.5	45.0	91.0	12.0	.....	44.5
13	58.5	30.5	42.5	100.0	6.5	.....	44.5	29	63.5	.....	45.2	89.0	7.5	0.0	51.5
14	75.0	50.0	48.5	104.0	6.2	.....	51.5	30	65.0	.....	46.5	80.0	0.0	32.5	48.0
15	59.0	49.0	45.5	106.5	6.5	.....	51.5	31	65.5	.....	46.0	.....	0.0	.....	48.0
16	60.0	59.5	42.0	108.0	6.8	.....	38.5								

NOTE.—Total flow of river diverted for irrigation May 30 to November 29. Daily discharge obtained by indirect method for shifting channels. Discharge interpolated December 9 and 31.

Estimated monthly discharge of Spanish Fork near Lake Shore, Utah, for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	75	22.5	54.2	3,333
February	95.5	30.5	66.0	3,665
March	72	27.5	50.1	3,080
April	129	61	90.1	5,361
May	83	0	17.9	1,101
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	32.5	0	1.08	64
December	51.5	31.5	42.7	2,626
The year	129	0	26.8	19,230

SEVIER RIVER BASIN.

SEVIER RIVER NEAR GUNNISON, UTAH.

Sevier River rises in the northwestern part of Kane County, in southern Utah, flows northeastward to a point near Gunnison, northwestward nearly to Leamington, and then turns sharply to the southwest and discharges into Sevier Lake.

Tributary streams are few, San Pitch River and Salina Creek being the most important. The San Pitch joins the main stream about 3 miles above the gaging station, but since its flow is used for irrigation and is completely controlled by storage reservoirs, it furnishes little of the supply. Salina Creek, which enters about 15 miles above the station, is subject to rapid run-off and during flood seasons carries an immense amount of sediment.

There is considerable irrigation from the Sevier above Gunnison, and a few small storage reservoirs control the flood discharge.

The station was established June 29, 1900. It is located at the wagon bridge over the Sevier about 4 miles west of Gunnison, on the road to Westview precinct.

The channel is straight for about 300 feet above and below the station, with banks sufficiently high to prevent overflow. The bed of the stream is composed of sand and gravel and is smooth and apparently permanent. The current is sluggish at low water, but at ordinary stages ranges from 2 to 3 feet per second. At the high-water section the velocity is greatest at the right side, decreasing somewhat uniformly toward the left, where it is low. Floating ice during the winter season may make records at certain stages impossible. There is a free flow at the low-water but not at the high-water section.

During ordinary stages discharge measurements are made from the upstream side of the bridge, the floor of which is marked at 5-foot intervals, beginning at the bridge pile to which the gage is attached, this being the initial point for soundings. At extreme low water the velocity at this point is too low for favorable results, and measurements are made by wading at a point about 75 feet below the bridge, marked by a 2 by 4 inch post on each bank. The initial point for soundings at this section is the post on the left bank.

The gage is read daily by L. H. Erickson, a farmer. The original gage is a 1 by 4 inch piece of redwood nailed vertically to a bridge pier on the right bank on the upstream side of the bridge. In January, 1905, a new 6 by 6 inch inclined gage was established at a point about 25 feet below the old one. It is fastened to double posts set in the bank. Both gages have the same datum and are referred to bench marks as follows: (1) A large spike driven into the side of a cedar post 46 feet S. 74° E. from the gage; elevation, 8.55 feet. (2) A nail in the top of railing post at the northeast corner of the bridge 13 feet north of the gage; elevation, 13.18 feet. (3) A United States Geological Survey standard iron post set in the ground 153 feet S. 84° 30′ E. from the old gage; elevation, 10.10 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS = Water-Supply Paper):

Description: WS 51, p 425; 66, p 126; 85, p 88; 100, pp 147-148; 133, pp 277-278.
Discharge: WS 51, p 425; 66, p 126; 85, p 88; 100, p 148; 133, p 278.
Discharge, monthly: Ann 22, iv, p 420; WS 75 p 197; 85, p 90; 100, p 149; 133, p 280.
Gage heights: WS 51, p 426; 66, p 126; 85, p 89; 100, pp 148-149; 133, p 279.
Hydrograph: Ann 22, iv, p 420.
Rating tables: WS 52, p 521; 66, p 176; 85, p 89; 100, p 148; 133, p 280.

Discharge measurements of Sevier River near Gunnison, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 19[a]	C. Tanner	50	123	2.60	2.25	320
Febrary 7[a]	do	50	120	2.50	2.20	301
April 23	W. G. Swendsen	36	35	1.47	.80	52
June 19	C. S. Jarvis	35	32	1.51	.76	49
July 1	do	30	22	.89	.42	20
August 11	do	29	25	1.17	.53	30

[a] Measured at bridge.

Daily gage height, in feet, of Sevier River near Gunnison, Utah, for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			2.4	1.1	.72	2.8	.4	.5	.7	.86	.....	1.14
2			2.4	1.1	.7	2.86	.4	.5	.7	1.0	1.16	1.3
3			2.44	1.1	.7	2.96	.4	.5	.9	1.0	1.16	1.2
4			2.34	1.1	.72	2.7	.4	.5	.86	1.02	1.16	1.2
5			2.28	1.14	.7	2.46	.....	.5	.7	1.06	1.14	1.14
6		2.3	2.1	1.1	.7	2.38	.4	.5	.7	1.06	1.14	1.16
7		2.2	1.88	1.1	.7	2.36	.4	.54	.74	1.08	1.16	1.16
8		2.2	1.7	1.12	.76	2.24	.42	.54	.74	1.1	1.16	1.18
9		2.16	1.76	.....	.78	2.2	.4	.54	.76	1.1	1.14	1.16
10		2.22	1.96	1.12	.84	1.76	.4	.54	.9	1.14	1.14	.....
11		2.18	1.9	1.12	.96	1.76	.42	.54	.86	1.16	1.12	1.16
12		2.26	1.88	1.06	.98	1.56	.4	.56	.7	1.18	1.12	1.18
13		2.6	1.84	1.0	1.0	1.2	.4	.56	.7	1.18	1.12	1.2
14		3.1	1.8	.9	1.04	1.1	.4	.56	.72	1.2	1.12	1.2
15		2.0	1.76	.9	1.24	.9	.4	.56	.7	1.18	1.14	1.18
16		2.0	.....	.86	1.56	.9	.42	.56	.7	1.14	1.12	.....
17		2.02	1.64	.84	1.58	.8	.42	.56	.7	1.1	1.12	.....
18	2.0	2.0	1.6	.78	1.6	.82	.4	.56	.7	1.1	1.1	.....
19	2.25	2.0	1.58	.8	1.66	.82	.4	.56	.7	1.1	1.1	.....
20	2.2	2.0	1.62	.8	1.7	.76	.4	.58	.7	1.1	1.1	.....
21	2.2	2.12	1.56	.78	1.74	.7	.....	.58	.7	1.12	1.1	.....
22	2.2	2.22	.....	.78	1.76	.56	.4	.58	.7	1.16	1.1	.....
23	2.06	2.26	1.5	.....	1.94	.52	.4	.6	.72	1.16	1.12	.....
24	2.2	2.38	1.4	.9	2.44	.5	.4	.6	.74	1.16	1.12	.....
25	2.22	2.38	1.4	.82	3.25	.46	.4	.6	.74	1.16	1.12	.....
26	2.24	2.38	1.34	.78	3.23	.44	.44	.86	.78	1.14	1.12	.....
27	2.26	2.3	1.24	.78	3.3	.42	.44	.96	.78	1.14	1.14	.....
28	2.22	2.3	.....	.74	3.32	.4	.52	.8	.8	1.16	1.14	.....
29	2.22	.....	1.16	.7	3.22	.4	.52	.74	.82	1.16	1.14	.....
30	2.26	.....	1.1	.7	3.24	.4	.5	.7	.86	1.16	1.14	.....
31	2.24	.....	1.14	.....	2.6	.....	.5	.7	.....	1.18	.....	.....

NOTE.—River frozen January 1-17 and December 16-31.

Station rating table for Sevier River near Gunnison, Utah, from January 18 to December 15, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	17	1.20	101	2.00	254	2.80	474
0.50	24	1.30	116	2.10	278	2.90	506
0.60	32	1.40	132	2.20	303	3.00	539
0.70	41	1.50	149	2.30	329	3.10	573
0.80	51	1.60	168	2.40	356	3.20	608
0.90	62	1.70	188	2.50	384	3.30	644
1.00	74	1.80	209	2.60	413	3.40	681
1.10	87	1.90	231	2.70	443		

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 0.4 foot and 1 foot and fairly well defined above 1 foot.

Estimated monthly discharge of Sevier River near Gunnison, Utah, for 1905.

[Drainage area, 3,986 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 18-31	319	254	303	8,414	0.076	0.040
February	573	254	318	17,660	.080	.083
March	367	87	199	12,240	.050	.058
April	92	41	67.0	3,987	.017	.019
May	651	41	222	13,650	.056	.065
June	525	17	164	9,759	.041	.046
July	26	17	18.4	1,131	.0046	.0053
August	69	24	32.3	1,986	.0081	.0093
September	62	41	46.2	2,749	.012	.013
October	101	58	89.3	5,491	.022	.025
November	95	87	91.4	5,439	.023	.026
December 1-15	116	93	98.3	2,925	.025	.014
The period				85,430		

NOTE.—Discharge interpolated on days when gage heights were missing.

SAN PITCH RIVER NEAR GUNNISON, UTAH.

San Pitch River, which enters Sevier River from the north, flows throughout its course in a well-defined channel with no overflow. Over the lower portions of the area evaporation and seepage doubtless exceed inflow to the stream. There are small tracts of irrigated land at various points along the river, and a storage reservoir about 10 miles above the gaging station completely controls the flow. The tributaries are few and mostly intermittent. Manti Creek, which enters at a point about 11 miles above the station, drains a barren area and is subject to rapid run-off. Its discharge may vary from 4 to 150 second-feet, but it enters above the reservoir dam and is thus completely controlled before reaching the gaging station.

The station was established June 30, 1900. It is located 4 miles northeast of Gunnison about one-eighth mile west of the Rio Grande Western Railway, west of the second farmhouse along the railroad track north of Gunnison station.

The channel is straight for about 100 feet above and is slightly curved below the station. Both banks slope gradually and are sufficiently high to prevent overflow. The bed of the stream is composed of sand and gravel, and is smooth and apparently permanent. The velocity is high. Information in regard to winter conditions is indefinite.

Discharge measurements are made by wading at a point near the gage, where a tagged wire is stretched. The initial point for soundings is the west side of the supporting post on the left bank.

The gage, which is read daily by Oliver Peterson, is a vertical staff driven into the stream bed. It is referred to bench marks as follows: (1) The top of a cedar post set about 45.5 feet west from the gage; elevation, 5.96 feet. (2) Top of nail driven into top of stake set about 150 feet S. 84° E. from the initial point; elevation, 10.36 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 51, p 425; 66, p 125; 85, p 94; 100, p 150; 133, p 281.
Discharge: WS 51, p 425; 66, p 125; 85, p 94; 100, p 150; 133, p 281.
Discharge, monthly: Ann 22, iv, p 419; WS 75, p 196; 85, p 96; 100, p 152; 133, p 283.
Gage heights: WS 51, p 425; 66, p 125; 85, p 95; 100, p 151; 133, p 282.
Hydrograph: Ann 22, iv, p 419.
Rating tables: WS 52, p 521; 66, p 176; 85, p 95; 100, p 151; 133, p 282.

Discharge measurements of San Pitch River near Gunnison, Utah, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 18	C. Tanner	23	20	0.60	1.76	12
June 19	C. S. Jarvis	31	40	2.92	2.46	116
July 1	do	29	36	2.63	2.40	9[illegible]
August 12	do	29	40	2.88	2.46	114

Daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1905

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.78	1.78	1.8	1.76	2.44	3.0	2.44	2.54	2.0	2.08	1.96	1.9
2	1.78	1.9	1.78	1.78	2.4	2.9	2.56	2.5	2.06	2.04	1.96	1.9
3	1.78	1.9	1.78	1.78	2.3	2.76	2.54	2.52	2.04	2.04	2.0	1.9
4	1.78	1.9	1.76	1.78	2.3	2.8	2.54	2.5	2.06	2.02	2.0	1.9
5	1.8	1.88	1.76	1.78	2.3	3.1	2.5	2.5	2.08	2.02	1.98	1.9
6	1.8	1.88	1.76	1.78	2.36	2.82	2.58	2.5	2.08	2.02	1.96	1.92
7	1.8	1.86	1.74	1.8	2.3	2.88	2.6	2.5	2.02	2.0	1.96	1.9
8	1.78	1.84	1.7	1.8	2.32	2.9	2.68	2.5	2.04	2.0	1.96	1.9[illegible]
9	1.78	1.8	1.7	1.8	2.5	2.88	2.66	2.5	2.02	2.0	1.98	1.9[illegible]
10	1.78	1.74	1.68	1.84	2.5	2.86	2.64	2.5	2.02	2.0	1.96	1.9[illegible]
11	1.8	1.74	1.68	1.8	2.5	3.0	2.66	2.5	2.04	1.94	1.92	1.9[illegible]
12	1.8	1.72	1.7	1.8	2.5	3.14	2.64	2.56	2.02	1.94	1.92	1.9[illegible]
13	1.73	1.7	1.72	1.8	2.52	2.88	2.64	2.46	2.0	1.94	1.92	1.9
14	1.78	1.7	1.73	1.8	2.6	2.9	2.6	2.44	2.06	1.94	1.92	1.9
15	1.76	1.7	1.78	1.8	2.6	2.88	2.64	2.44	2.06	1.94	1.92	1.9
16	1.78	1.68	1.78	1.8	2.78	2.8	2.64	2.46	2.04	1.92	1.92	1.9
17	1.78	1.68	1.78	1.82	2.74	2.7	2.6	2.42	2.03	1.94	1.92	1.92
18	1.76	1.68	1.78	1.84	2.52	2.78	2.6	2.4	2.02	1.94	1.94	1.92
19	1.78	1.68	1.78	1.84	2.8	2.6	2.6	2.36	2.02	1.94	1.94	1.94
20	1.76	1.68	1.8	1.84	2.34	2.52	2.6	2.36	2.02	1.96	1.96	1.9[illegible]

Daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1905—Continued.

Daily.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	1.74	1.68	1.8	1.84	2.54	2.4	2.6	2.36	2.02	1.96	2.0	1.96
22	1.74	1.78	1.8	1.8	3.24	2.5	2.6	2.36	2.02	1.96	2.0	1.96
23	1.74	1.72	1.78	1.82	2.8	2.42	2.58	2.36	2.02	1.96	1.88	1.96
24	1.74	1.74	1.78	1.88	2.78	2.44	2.54	2.36	2.0	1.96	1.88	1.9
25	1.74	1.78	1.78	1.8	2.7	2.38	2.54	2.36	2.0	1.96	1.88	1.86
26	1.74	1.78	1.66	1.9	2.6	2.34	2.54	2.3	2.0	1.96	1.9	1.86
27	1.74	1.78	1.66	2.0	2.5	2.42	2.54	2.24	2.0	1.96	1.92	1.86
28	1.76	1.8	1.68	2.34	2.6	2.4	2.54	2.22	1.96	1.96	1.9	1.86
29	1.74	.....	1.66	2.34	2.4	2.42	2.56	4.15	2.3	1.96	1.9	1.86
30	1.74	.....	1.68	2.36	2.32	2.42	2.56	2.36	2.08	1.96	1.9	1.86
31	1.74	.....	1.73	.....	2.6	.....	2.56	2.2	.....	1.96	.....	1.86

Station rating table for San Pitch River near Gunnison, Utah, from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	10	2.10	49	2.50	123	2.90	227
1.80	15	2.20	64	2.60	146	3.00	258
1.90	24	2.30	82	2.70	171	3.10	290
2.00	35	2.40	102	2.80	198	3.20	324

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902-1905. It is well defined between gage heights 1.65 feet and 2.5 feet.

Estimated monthly discharge of San Pitch River near Gunnison, Utah, for 1905.

[Drainage area, 836 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	15	11	13.3	818	0.016	0.018
February	24	9	14.1	783	.017	.018
March	15	8	12.1	744	.014	.016
April	94	13	24.2	1,440	.029	.032
May	338	82	136	8,362	.163	.188
June	304	90	179	10,650	.214	.239
July	166	110	143	8,793	.171	.197
August	720	64	126	7,747	.151	.174
September	82	30	40.5	2,410	.048	.054
October	46	26	32.0	1,968	.038	.044
November	35	22	28.1	1,672	.034	.038
December	30	20	23.9	1,470	.029	.033
The year	338	8	64.3	46,860	.077	1.05

NOTE.—Open-channel curve assumed to apply throughout the year as the stream is known to freeze but slightly at this station.

HUMBOLDT SINK DRAINAGE.

The only stream of importance draining into Humboldt Sink is Humboldt River, the basin of which is described below.

HUMBOLDT RIVER BASIN.

DESCRIPTION OF BASIN.

Humboldt River rises in the extreme northeastern part of Nevada, flows west and southwest across the structural features of the country, and enters Humboldt Lake, whence its waters find their way into Humboldt Sink. The tributaries follow the general direction of the mountain ranges and flow either to the north or to the south. During low stages the water of the river is almost wholly diverted, and for the future development of the country recourse must be had to the construction of storage reservoirs.

Of the tributaries, North Fork enters the stream west of Peko, Nev., and South Fork about 10 miles below Elko. Pine Creek comes in from the south near Palisade, Nev. Marys River is one of the headwater branches.

NORTH FORK OF HUMBOLDT RIVER NEAR ELBURZ, NEV.

This station was established October 10, 1902. It is located about one-fourth mile above the junction of North Fork with the main River and 150 feet below the Southern Pacific Railroad bridge. It is 2 miles west of the Southern Pacific Railroad station at Elburz. The nearest post-office is Halleck, Nev.

The channel is straight for 150 feet above and below the station. Both banks are high, but the left will overflow at extreme flood stages. The bed of the stream is composed of gravel and silt and changes slightly. There is but one channel at all stages, and the current is sluggish.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero on the tagged wire.

The gage, which is read once each day by A. R. Blevins, is an inclined 4 by 4 inch timber fastened to the left bank just above the cable. The bench mark is a 4 by 4 inch timber driven into the ground on the left bank 20 feet upstream from the gage; elevation above zero of gage, 6.99 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 163; 133, p 283.
Discharge: 100, p 164; 133, p 284.
Discharge, monthly: 133, p 285.
Gage heights: 100, p 164; 133, p 284.
Rating table: 133, p 285.

Discharge measurements of North Fork of Humboldt River near Elburz, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 27	W. A. Wolf	37	26	1.13	3.30	29.5
May 20	do	37	27	1.18	3.35	32
June 4	do	37	32	1.25	3.50	40
July 14	do				2.80	[a] 1

[a] Discharge estimated.

Daily gage height, in feet, of North Fork of Humboldt River near Elburz, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	3.5	3.4	3.5	3.4	3.55	2.85	2.2	2.55	2.6	3.3	3.0
2	3.6	3.5	3.4	3.5	3.5	3.55	2.85	2.2	2.55	2.6	3.3	3.0
3	3.6	3.45	3.45	3.45	3.55	3.5	2.8	2.2	2.55	2.6	3.3	3.0
4	3.6	3.4	3.45	3.45	3.55	3.55	2.8	2.2	2.55	2.6	3.3	3.0
5	3.6	3.35	3.5	3.4	3.6	3.5	2.8	2.2	2.55	2.6	3.2	3.0
6	3.55	3.35	3.5	3.35	3.6	3.5	2.8	2.15	2.55	2.6	3.1	3.0
7	3.55	3.35	3.5	3.35	3.6	3.5	2.8	2.15	2.55	2.6	3.0	3.0
8	3.6	3.3	3.5	3.3	3.65	3.5	2.8	2.15	2.55	2.6	3.0	3.0
9	3.6	3.25	3.5	3.3	3.7	3.5	2.85	2.15	2.55	2.6	2.9	3.0
10	3.55	3.2	3.5	3.3	3.65	3.45	2.85	2.15	2.55	2.6	2.9	3.0
11	3.55	3.15	3.5	3.3	3.6	3.4	2.85	2.15	2.5	2.6	3.0	3.0
12	3.55	3.3	3.4	3.3	3.65	3.35	2.85	2.15	2.5	2.6	3.0	3.0
13	3.55	3.35	3.4	3.25	3.7	3.3	2.8	2.15	2.5	2.6	2.9	3.0
14	3.55	3.4	3.4	3.25	3.6	3.3	2.8	2.15	2.5	2.6	2.9	3.0
15	3.6	3.4	3.4	3.2	3.5	3.35	2.8	2.15	2.5	2.6	2.8	3.0
16	3.6	3.4	3.45	3.25	3.5	3.4	2.75	2.15	2.5	2.6	2.8	3.0
17	3.6	3.35	3.45	3.25	3.45	3.4	2.75	2.15	2.5	2.6	2.7	3.1
18	3.6	3.3	3.5	3.3	3.4	3.3	2.75	2.15	2.5	2.6	2.7	3.1
19	3.6	3.3	3.5	3.3	3.35	3.25	2.75	2.15	2.55	2.6	2.7	3.1
20	3.8	3.3	3.5	3.3	3.35	3.2	2.7	2.15	2.55	2.6	2.7	3.2
21	3.8	3.3	3.5	3.35	3.3	3.15	2.7	2.15	2.6	2.6	2.7	3.2
22	3.8	3.3	3.5	3.35	3.35	3.15	2.7	2.2	2.6	2.6	2.7	3.3
23	3.75	3.25	3.5	3.3	3.4	3.15	2.65	2.3	2.6	2.7	2.7	3.4
24	3.7	3.3	3.45	3.3	3.45	3.15	2.65	2.4	2.6	2.7	2.7	3.4
25	3.6	3.3	3.45	3.25	3.55	3.1	2.6	2.5	2.6	2.8	2.7	3.5
26	3.6	3.3	3.5	3.3	3.55	3.1	2.55	2.5	2.6	2.9	2.8	3.5
27	3.6	3.25	3.5	3.3	3.6	3.1	2.4	2.5	2.6	2.9	2.85	3.5
28	3.6	3.3	3.45	3.3	3.6	3.0	2.32	2.55	2.6	3.0	2.9	3.5
29	3.6	.....	3.45	3.35	3.6	3.0	2.3	2.55	2.6	3.1	3.0	3.5
30	3.55	.....	3.45	3.4	3.55	3.0	2.25	2.6	2.6	3.2	3.0	3.5
31	3.5	.....	3.5	.....	3.6	.....	2.2	2.6	.....	3.3	.....	.....

NOTE.—Ice conditions exist at this station during the winter months. Ice 8 inches thick January 20.

Station rating table for North Fork of Humboldt River near Elburz, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	0.0	2.70	0.8	3.10	14	3.50	41
2.40	.2	2.80	1.	3.20	20	3.60	49
2.50	.4	2.90	3.	3.30	27	3.70	57
2.60	.6	3.00	8.	3.40	34	3.80	66

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. Estimates based on this table can be considered only as approximate, and especially so for low stages. Zero flow at 2.3 feet is based on observer's statement.

Estimated monthly discharge of North Fork of Humboldt River near Elburz, Nev., for 1905.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	66	41	53.3	3,277	0.052	0.060
February	41	17	29.0	1,611	.028	.029
March	41	34	38.8	2,386	.038	.044
April	41	20	28.9	1,720	.028	.031
May	57	27	43.8	2,693	.043	.050
June	45	8	28.0	1,666	.027	.030
July	2	.0	.96	59	.00094	.0011
August	.6	.0	.12	7	.00012	.00014
September	.6	.4	.50	30	.00049	.00055
October	27	.6	2.9	178	.0028	.0032
November	27	.8	7.8	464	.0076	.0085
December	41	8	19.1	1,174	.019	.022
The year	66	0	21.1	15,270	.021	.279

NOTE.—Open-channel rating table applied to the winter months without correction. Winter estimates liable to some error.

SOUTH FORK OF HUMBOLDT RIVER NEAR ELKO, NEV.

This station was established August 29, 1896. It is located 10 miles southwest of the town of Elko, at Cislini's (formerly Mason's) ranch, and about 6 miles above the junction of South Fork with the main stream.

The channel is straight for some distance above and below the station and the banks are high. The bed of the stream is composed of gravel and is stable. There is a good site for a reservoir a short distance above the station.

Discharge measurements are made from a cable and suspended car at a point 1 mile above the gage.

The gage, which is placed near the farm of the observer, M. Cislini, for his convenience, is inclined and is spiked to posts driven firmly into the right bank. An inclined gage was installed November 22, 1902, at the site of the old one, the 4-foot marks of the old and new gages coinciding. The bench mark is a 4 by 4 inch timber driven 4 feet south of the gage; elevation above gage datum, 6.29 feet. A new gage was installed May 21, 1905, below a dam which was built just below the old gage. All gage heights for 1905 have been referred to this new datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 311; WS 16, p 156; 28, p 146; 38 pp 327-328; 51, p 396; 66, p 105; 85, p 101, 100, p 161; 133, p 294.

Discharge: Ann 18, iv, p 311; WS 16, p 156; 28, p 153; 38, p 328; 51, p 396; 66, p 105; 85, p 102; 100, p 161; 133, p 295.

Discharge, monthly: Ann 19, iv, p 430; 20, iv, p 440; 21, iv, p 391; 22, iv, p 400; WS 75, p 182; 85, p 103, 100, p 163; 133, p 296.

Discharge, yearly: Ann 20, iv, p 60.

Gage heights: WS 11, p 76; 16, p 165; 28, pp 148-149; 38, p 328; 51, p 397; 66, p 106; 85, p 102; 100, p 162, 133, p 295.

Hydrographs: Ann 19, iv, p 430; 20, iv, p 441; 21, iv, p 391; 22, iv, p 400.

Rating tables: Ann 19, iv, p 429; WS 28, p 154; 39, p 452; 52, p 520; 66, p 174; 85, p 102; 100, p 162, 133, p 296.

Discharge measurements of South Fork of Humboldt River near Elko, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 26	W. A. Wolf	.....	109	2.24	1.55	244
May 21	do	47	167	3.81	3.85	636
June 4	do	46	157	3.62	3.60	568
June 16	do	46	181	4.30	4.31	779
June 27	do	45	122	2.89	2.88	324
July 14	do	45	86	1.40	1.95	120
September 7	do	.....	.....	.....	.60	[a] .5

[a] Estimated.

NOTE.—Beginning May 21 gage heights refer to new datum.

Daily gage height, in feet, of South Fork Humboldt River near Elko, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.5	0.85	(a)	0.4	2.3	3.55	2.75	1.0	1.0	0	1.0	1.1
2	.5	1.15	(a)	.5	2.1	3.6	2.75	1.0	1.0	0	1.0	1.1
3	.5	1.15	(a)	.5	2.3	3.6	2.8	1.0	1.0	0	1.0	1.1
4	.5	1.5	(a)	1.15	2.55	3.7	2.9	1.0	1.0	0	1.0	1.1
5	.5	1.5	(a)	1.15	2.55	3.7	3.0	1.0	1.0	0	1.0	1.1
6	.5	1.5	0.4	1.5	2.55	3.6	3.7	1.0	1.0	0	1.1	1.1
7	.5	1.15	.4	1.65	2.75	3.7	2.9	1.0	1.0	0	1.1	1.1
8	.5	.5	(a)	1.8	2.9	3.8	2.7	1.0	.6	0	1.1	1.1
9	.5	.5	(a)	1.8	3.0	3.9	2.6	1.0	.6	0	1.1	1.1
10	.5	.5	.4	2.1	3.15	3.8	2.5	1.0	.6	0	1.1	1.1
11	.5	.5	.4	2.3	3.15	3.8	2.4	1.0	.6	0	1.1	1.1
12	.5	.5	.4	2.1	3.3	3.9	2.4	1.0	.6	0	1.1	1.1
13	.5	.4	.4	2.1	3.35	4.0	2.4	1.0	.6	0	1.1	1.1
14	.5	.4	.4	1.8	3.4	4.1	2.4	1.0	.6	0	1.1	1.1
15	.5	(a)	.4	1.8	3.5	4.2	2.45	1.0	.6	1.0	1.1	1.1
16	.5	(a)	.4	2.1	3.65	4.3	2.4	1.0	.6	1.0	1.1	1.1
17	.5	(a)	.4	2.1	3.75	4.4	2.2	1.0	.6	1.0	1.1	1.1
18	.5	(a)	.4	2.2	3.85	4.3	2.1	1.0	.6	1.0	1.1	1.1
19	.5	(a)	.4	2.2	3.85	4.1	2.0	1.0	.6	1.0	1.1	1.1
20	.5	(a)	.4	2.3	3.85	4.0	1.8	1.0	.6	1.0	1.1	1.1
21	.5	(a)	.4	2.3	3.8	3.8	1.7	1.0	.6	1.0	1.1	1.1
22	.5	(a)	.4	2.55	3.7	3.7	1.6	1.0	.6	1.0	1.1	1.1
23	.5	(a)	.4	2.55	3.7	3.5	1.5	1.0	.6	1.0	1.1	1.1
24	.5	(a)	.4	2.55	3.6	3.3	1.4	1.0	0	1.0	1.1	1.1
25	.5	(a)	.4	2.55	3.6	3.2	1.4	1.0	0	1.0	1.1	1.1
26	.5	.4	.4	2.55	3.5	3.1	1.4	1.0	0	1.0	1.1	1.1
27	.5	.4	.4	2.55	3.5	3.0	1.3	1.0	0	1.0	1.1	1.1
28	.5	.4	.4	2.55	3.6	3.0	1.3	1.0	0	1.0	1.1	1.1
29	.5	.....	.4	2.55	3.5	2.9	1.2	1.0	0	1.0	1.1	1.1
30	.5	.....	.5	2.3	3.55	2.8	1.1	1.0	0	1.0	1.1	1.1
31	.5	.....	.4	.....	3.55	.....	1.1	1.0	.....	1.0	.....	1.1

[a] No flow.

Station rating table for South Fork Humboldt River near Elko, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	0	1.70	88	2.90	350	4.10	720
.60	1	1.80	102	3.00	380	4.20	752
.70	3	1.90	117	3.10	410	4.30	784
.80	7	2.00	133	3.20	440	4.40	816
.90	12	2.10	150	3.30	470	4.50	848
1.00	18	2.20	168	3.40	500	4.60	880
1.10	25	2.30	189	3.50	530	4.70	912
1.20	33	2.40	212	3.60	560	4.80	944
1.30	42	2.50	238	3.70	592	4.90	976
1.40	52	2.60	264	3.80	624	5.00	1,008
1.50	63	2.70	292	3.90	656		
1.60	75	2.80	320	4.00	688		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1905. It is fairly well defined between gage heights 2 feet and 4 feet. Below 2 feet the table is based on one measurement at 0.6 foot.

Estimated monthly discharge of South Fork Humboldt River near Elko, Nev., for 1905.

[Drainage area, 1,150 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	0	0	0	0	0	0
February	63	0	10.2	567	.0089	.0093
March	0	0	0	0	0	0
April	251	0	149	8,866	.130	.145
May	640	150	465	28,590	.404	.466
June	816	320	588	34,990	.511	.570
July	592	25	187	11,500	.163	.188
August	18	18	18	1,107	.016	.018
September	18	0	4.7	280	.0041	.0046
October	18	0	9.9	608	.0086	.0099
November	25	18	24.7	1,470	.021	.023
December	25	25	25	1,537	.022	.025
The year	816	0	123	89,520	.107	1.46

HUMBOLDT RIVER AT PALISADE, NEV.

This station was established November 27, 1902. It is located at the single-span highway bridge one-fourth mile from the hotel at Palisade, Nev. There is a railroad bridge about 500 feet below.

The channel is straight for 200 feet above and 300 feet below the station. The right bank is low and liable to overflow; the left is high. The bed of the stream is composed of gravel and sand and is permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car about one-fourth mile above the gage. At very low stages, when the current becomes sluggish at the cable, measurements are made by wading a short distance above. The initial point for soundings is the zero on the tagged wire.

The gage, which is read once each day by T. H. Jewell, the hotel keeper, is a vertical 1 by 4 inch board spiked to the right abutment of the bridge. The bench mark consists

of a spike and three nails driven into the bridge abutment to which the gage is fastened; elevation above zero of gage, 7.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 100; 100, p 157; 133, p 286.
Discharge: 100, p 158; 133, p 286.
Discharge, monthly: 100, p 159; 133, p 288.
Gage heights: 85, p 100; 100, p 158; 133, p 287.
Rating table 100, p 159; 133, p 287.

Discharge measurements of Humboldt River at Palisade, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 27	W. A. Wolf	102	258	1.88	3.10	485
May 20	do	105	365	2.33	4.10	850
June 4	do	105	414	2.23	4.20	923
June 20	do	105	358	2.12	3.85	759
June 27	do	105	358	2.11	3.85	756
July 15	do	97	204	1.40	2.35	284
September 8	do	10	10	1.30	.90	13

Daily gage height, in feet, of Humboldt River at Palisade, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	2.0	2.4	2.6	2.95	4.6	3.2	1.6	1.1	1.15	1.4	1.4
2	1.95	2.1	2.4	2.6	3.0	4.6	3.2	1.6	1.1	1.15	1.4	1.4
3	1.95	2.1	2.4	2.6	3.05	4.6	3.15	1.6	1.1	1.15	1.4	1.46
4	1.95	2.2	2.4	2.6	3.1	4.55	3.1	1.6	1.1	1.15	1.4	1.46
5	1.95	2.2	2.4	2.6	3.15	4.55	3.1	1.55	1.1	1.2	1.4	1.46
6	1.95	2.2	2.4	2.6	3.2	4.55	3.0	1.55	1.1	1.2	1.4	1.46
7	1.95	2.2	2.4	2.6	3.3	4.5	2.9	1.5	1.1	1.2	1.4	1.46
8	1.9	2.2	2.4	2.6	3.3	4.5	2.85	1.5	1.1	1.2	1.4	1.46
9	1.9	2.1	2.4	2.6	3.35	4.5	2.8	1.5	1.1	1.2	1.4	1.46
10	1.8	2.1	2.4	2.6	3.4	4.45	2.75	1.5	1.1	1.2	1.4	1.4
11	1.8	2.1	2.4	2.65	3.5	4.45	2.7	1.5	1.1	1.2	1.4	1.4
12	1.7	2.0	2.4	2.75	3.5	4.4	2.6	1.5	1.1	1.2	1.4	1.4
13	1.7	2.0	2.4	2.8	3.6	4.2	2.5	1.5	1.1	1.2	1.4	1.4
14	1.7	2.0	2.4	2.8	3.65	4.0	2.4	1.5	1.1	1.2	1.4	1.4
15	1.7	2.0	2.4	2.8	3.7	4.0	2.3	1.5	1.1	1.2	1.4	1.4
16	1.7	2.0	2.4	2.9	3.8	4.0	2.3	1.5	1.1	1.25	1.4	1.4
17	1.7	2.0	2.4	2.9	3.9	3.95	2.3	1.4	1.1	1.25	1.4	1.45
18	1.7	2.1	2.4	2.9	4.0	3.9	.2	1.3	1.1	1.3	1.4	1.45
19	1.75	2.1	2.4	2.9	4.0	3.9	2.1	1.25	1.1	1.3	1.4	1.45
20	1.75	2.1	2.4	2.95	4.2	3.85	2.0	1.2	1.1	1.3	1.4	1.5
21	1.8	2.2	2.45	2.95	4.2	3.85	2.0	1.15	1.1	1.3	1.4	1.5
22	1.8	2.2	2.5	2.95	4.2	3.8	1.9	1.1	1.1	1.35	1.4	1.5
23	1.8	2.2	2.5	2.95	4.2	3.8	1.9	1.1	1.1	1.35	1.4	1.5
24	1.85	2.3	2.5	2.95	4.3	3.7	1.9	1.1	1.1	1.35	1.4	1.55
25	1.95	2.3	2.55	2.95	4.4	3.7	1.8	1.1	1.1	1.35	1.4	1.55
26	1.9	2.4	2.6	2.95	4.5	3.6	1.75	1.1	1.1	1.35	1.4	1.55
27	1.9	2.4	2.6	2.95	4.6	3.5	1.75	1.1	1.1	1.4	1.4	1.6
28	1.9	2.4	2.6	2.95	4.7	3.4	1.75	1.1	1.1	1.4	1.4	1.6
29	1.9	.....	2.6	2.95	4.8	3.3	1.75	1.1	1.1	1.4	1.4	1.65
30	2.0	.....	2.6	2.95	4.7	3.2	1.75	1.1	1.1	1.4	1.4	1.7
31	2.0	.....	2.6	.....	4.6	.....	1.6	1.1	.....	1.4	.....	1.7

Station rating table for Humboldt River at Palisade, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	34	2.10	203	3.10	498	4.00	850
1.20	46	2.20	227	3.20	534	4.10	895
1.30	59	2.30	253	3.30	570	4.20	940
1.40	72	2.40	280	3.40	607	4.30	985
1.50	86	2.50	308	3.50	645	4.40	1,030
1.60	102	2.60	337	3.60	684	4.50	1,075
1.70	120	2.70	367	3.70	724	4.60	1,120
1.80	139	2.80	398	3.80	765	4.70	1,170
1.90	159	2.90	430	3.90	807	4.80	1,220
2.00	180	3.00	463				

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is fairly well defined.

Estimated monthly discharge of Humboldt River at Palisade, Nev., for 1905.

[Drainage area, 5,014 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	180	120	149	9,162	0.030	0.035
February	280	180	216	12,000	.043	.045
March	337	280	296	18,200	.059	.068
April	446	337	397	23,620	.079	.088
May	1,220	446	793	48,760	.158	.182
June	1,120	534	884	52,600	.176	.196
July	534	102	286	17,580	.057	.066
August	102	34	66.6	4,095	.013	.015
September	34	34	34.0	2,023	.0068	.0076
October	72	40	54.7	3,363	.011	.013
November	72	72	72.0	4,284	.014	.016
December	120	72	85.2	5,239	.017	.020
The year	1,220	34	278	200,900	.055	.752

NOTE.—Ice conditions not known. Open-channel rating table applied to the winter months without correction.

HUMBOLDT RIVER NEAR GOLCONDA, NEV.

This station was established October 24, 1894. It is located 1¼ miles north of the town of Golconda, near the great northern bend of Humboldt River and below the central valley, and is about 12 miles above the mouth of Little Humboldt River.

The channel is straight for 300 feet above and 100 feet below the station. The banks are moderately high, but are liable to overflow at extreme high water. The bed of the stream is of gravel and sand and is somewhat shifting. There is but one channel at all stages.

Measurements prior to 1904 were made from a cable and suspended car. Subsequent measurements have been made from the upper side of a wagon bridge, constructed during the winter of 1903–4, 10 feet above the cable. At low stages, when the current is sluggish, measurements can be made by wading above or below the cable.

The gage was read during 1905 by Charles Shallenberger. A new gage and bench mark were established October 4, 1904, replacing the inclined gage installed November 28, 1902, which was fastened to the left bank by 4 by 4 inch stakes, and the zero of which had the same elevation as the original gage. The new gage is a 4 by 4 inch timber, driven vertically into the river bed, and its upper end is securely fastened to a stringer on the downstream side of the north or right end of the wagon bridge. The bench mark of the old gage was a 4 by 4 inch timber, driven 4 feet north of the cable post on the left bank, at an elevation of 10.75 feet above the zero of the gage. The new bench mark is the head of the lowest rivet of the strut at the northwest corner of the bridge; elevation above zero of new gage, 13.42 feet. The new bench mark is 0.48 foot lower than the old bench mark, so that the new gage zero is 3.15 feet below the old zero.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 303-304; Bull 131, p 52; 140, pp 217-218; WS 16, p 154; 28, p 146; 38, p 329; 51, p 397; 66, p 106; 85, p 98; 100, p 155; 133, pp 288-289.

Discharge: Ann 18, iv, pp 304-305; Bull 131, p 92; 140, p 218; WS 16, p 154; 28, p 153; 38, p 329; 51, p 397; 66, p 106; 85, p 98; 100, p 155; 133, p 289.

Discharge, monthly: Ann 18, iv, p 306; 19, iv, p 427; 20, iv, p 438; 21, iv, p 392; 22, iv, p 401; Bull 140, p 220; WS 75, p 182; 85, p 100; 100, p 157; 133, p 291.

Discharge, yearly: Ann 20, iv, p 59.

Gage heights: Bull 140, p 219; WS 11, p 74; 16, p 154; 28, p 148; 38, p 329; 51, p 398; 66, p 107; 85, p 99; 100, p 156; 133, p 290.

Hydrographs: Ann 19, iv, p 429; 20, iv, p 439; 21, iv, p 392; 22, iv, p 401.

Rating tables: Ann 19, iv, p 427; WS 28, p 154; 39, p 452; 52, p 520; 66, p 175; 85, p 99; 100, p 156; 133, p 291.

Discharge measurements of Humboldt River near Golconda, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 25	W. A. Wolf	63	200	0.58	6.55	116
May 19	do	73	234	1.30	6.95	302
June 2	do	62	153	1.33	5.98	203
June 15	do	62	160	1.60	6.40	257
June 28	do	60	166	1.43	6.30	238
July 13	do	59	172	1.46	6.35	252
September 6	do				3.10	[a] 5

[a] Estimated.

Daily gage height, in feet, of Humboldt River near Golconda, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.7	6.2				7.4		4.7		3.0	3.0	3.0
2			6.2		7.0			4.7				
3	5.5					5.9		4.6		3.0		3.0
4		6.0		6.4	7.1	6.0	6.5	4.3		3.0		3.0
5	5.3	5.9	6.2	6.4	7.0		6.5			3.0		3.0
6			6.3		6.9	5.9	6.5	4.1	3.1		3.0	
7	5.5		6.3	6.0	7.0	6.2		4.1	3.1		3.0	
8	5.5	5.9		5.8			6.3		3.1		3.0	
9		6.0		6.5	6.8				3.1		3.0	2.9
10		6.1			6.4	6.2	6.3					
11	5.6					6.4		3.9				
12	5.3	6.0	6.2	6.8	6.4	6.2	6.0	3.9				2.9
13	5.0		6.2	7.0		6.0	6.0	3.7	3.0		3.0	2.9
14						6.0		3.7	3.0		3.0	2.9
15	5.0	5.8	6.1	7.0			5.9	3.6	2.9		3.0	2.9
16			6.3	7.0			5.7		2.8	2.9	3.0	
17		5.6		7.0	6.9							
18	5.3	5.6			6.9	6.0		3.4	2.9	3.0		
19		5.6	5.6	6.8	6.9	6.0	5.5			2.9		
20	5.6				7.0					3.0	3.0	
21	6.3						5.4	3.3	3.0			3.0
22	5.8	5.7	6.0	6.5	7.0	6.3	5.4	3.3	3.0		2.9	3.0
23			6.0			6.5			3.0	2.9	3.0	3.0
24		5.9	6.0	6.5	7.1			3.2		2.9	3.0	3.0
25	5.4	5.9	6.2	6.4	7.3	6.9	5.1			3.0		
26		6.0	5.9				5.1	3.0	3.0		3.0	3.0
27	5.2			6.8	7.3	6.9		3.1			3.0	2.9
28	5.4		6.0			6.5	5.0		3.0			3.0
29				7.0			4.9	3.1	3.0	3.0		3.0
30	5.4		6.4		7.4	6.5		3.0	2.9	3.0		
31	6.0		6.4		7.4			3.1		3.0		

Station rating table for Humboldt River near Golconda, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.80	0.0	4.00	39.0	5.20	132.0	6.40	247.0
2.90	0.1	4.10	46.0	5.30	141.0	6.50	257.0
3.00	.3	4.20	53.0	5.40	150.0	6.60	268.0
3.10	.5	4.30	60.0	5.50	159.0	6.70	279.0
3.20	2.0	4.40	67.0	5.60	168.0	6.80	290.0
3.30	5.0	4.50	75.0	5.70	177.0	6.90	301.0
3.40	8.0	4.60	83.0	5.80	187.0	7.00	312.0
3.50	12.0	4.70	91.0	5.90	197.0	7.10	323.0
3.60	16.0	4.80	99.0	6.00	207.0	7.20	334.0
3.70	21.0	4.90	107.0	6.10	217.0	7.30	345.0
3.80	27.0	5.00	115.0	6.20	227.0	7.40	356.0
3.90	33.0	5.10	123.0	6.30	237.0		

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905 and the form of previous curves. It is well defined between gage heights 6 feet and 7 feet. Below gage height 6 feet it is only approximate.

Estimated monthly discharge of Humboldt River near Golconda, Nev., for 1905.

[Drainage area, 10,780 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	237	115	155	9,531	0.014	0.016
February	227	168	196	10,880	.018	.019
March	247	168	218	13,400	.020	.023
April	312	187	272	16,180	.025	.028
May	356	247	308	18,940	.029	.033
June	356	197	239	14,220	.022	.024
July	257	95	184	11,310	.017	.020
August	91	.3	25.0	1,537	.0023	.0026
September	.5	.0	.33	19.6	.000031	.000035
October	.3	.1	.23	14.1	.000021	.000024
November	.3	.1	.29	17.3	.000027	.000030
December	.3	.1	.22	13.5	.000020	.000023
The year	356	0	133	96,060	.012	.166

NOTE.—Ice conditions not known. Open-channel rating table applied to the winter months without correction. Discharge interpolated on days when gage was not read.

HUMBOLDT RIVER NEAR OREANA, NEV.

This station was established January 27, 1896. It is located near Oreana, Nev., about 12 miles northeast of Lovelocks. The results of the observations at this locality show the amount of water available for storage at the possible reservoir sites in the vicinity of Humboldt station, and also for the six canal systems now in operation below Oreana.

The channel is straight for 300 feet above and 200 feet below the station. The right bank is high and will not overflow; the left bank will overflow only at extreme high water. There is but one channel at all stages. The bed of the stream is sandy and shifting.

Discharge measurements are made at high water by means of a cable and car located at the gage. At low water measurements are made by wading a short distance below the station.

The gage was read once each day during 1905 by J. J. McCarthy. The original gage was located at the old Oreana highway bridge. The abutment to which the gage was fastened was undermined and fell May 26, 1897. A temporary gage was used until September 8, 1897, when a new inclined one was placed on the left bank of the river, about 1½ miles above the site of the old gage and opposite the section house of the Central Pacific Railroad. This gage was washed out. The present gage was established November 29, 1902. It is vertical, in two sections, and is spiked to piles at the site of the old dam. The bench mark consists of four nails driven into the pile to which the upper section of the gage is fastened; elevation above zero of gage, 5.00 feet. On October 1, 1904, the gage rod was lowered 2.00 feet, and the elevation of the bench mark is now 7.00 feet above the zero of the gage:

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 306; Bull 140, p 220; WS 16, p 155; 28, p 146; 38, p 330; 51, p 398; 66, p 107; 85, p 96; 100, pp 152-153; 133, p 292.

Discharge: Ann 18, iv, p 307; WS 16, p 155; 28, p 153; 38, p 330; 51, p 398; 66, p 107; 85, p 97; 100, p 153; 133, p 292.

Discharge, monthly: Ann 18, iv, p 308; 19, iv, p 428; 20, iv, p 439; 21, iv, p 393; 22, iv, p 402; WS 75, p 183; 85, p 98; 100, p. 154; 133, p 294.

Discharge, yearly: Ann 20, iv, p 60.

Gage heights: WS 11, p 75; 16, p 155; 28, p 148; 38, p 330; 51, p 399; 66, p 108; 85, p 97; 100, p 153; 133, p 293.

Hydrographs: Ann 18, iv, p 309; 19, iv, p 429; 20, iv, p 440; 21, iv, p 393; 22, iv, p 402; WS 75, p 28[illegible]

Rating tables: Ann 18, iv, p 307; 19, iv, p 428; WS 28, p 154; 39, p 452; 52, p 520; 66, p 175; 85, p 97; 100, p 154; 133, p 293.

Discharge measurements of Humboldt River near Oreana, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 25	W. A. Wolf	60	39	1.34	2.11	52
May 18	do	22	12	1.12	1.71	13.4
May 30	do	20	10	1.08	1.61	10.8
July 12	do	100	112	1.77	2.95	198
July 31	do	100	100	1.70	2.75	173
September 5	do	16	16	0.90	1.78	14

Daily gage height, in feet, of Humboldt River near Oreana, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.9	3.0	3.75	2.6	1.8	1.6	1.0	2.75	1.8	1.75	1.9	2.1
2	3.6	2.9	3.1	2.6	1.95	1.55	1.0	2.7	1.8	1.75	1.9	2.1
3	3.4	3.0	3.1	2.65	1.8	1.55	1.0	2.6	1.85	1.7	1.9	2.1
4	3.5	2.9	3.1	2.7	1.75	1.55	1.55	2.6	1.85	1.7	1.9	2.1
5	3.5	2.9	3.1	2.7	1.75	1.55	1.6	2.55	1.8	1.75	1.95	2.15
6	3.4	2.8	3.1	2.7	1.6	1.5	1.65	2.55	1.8	1.75	1.95	2.15
7	3.4	2.8	3.1	2.7	1.65	1.5	1.8	2.6	1.85	1.75	1.95	2.1
8	3.5	2.7	3.12	2.6	1.65	1.5	1.8	2.6	1.85	1.75	1.9	2.1
9	3.4	2.7	3.11	2.6	1.64	1.5	2.95	2.55	1.8	1.75	1.9	2.1
10	3.2	3.0	3.11	2.6	1.65	1.45	3.45	2.55	1.8	1.8	1.9	2.1
11	3.1	3.1	3.1	2.55	1.75	1.4	3.3	2.5	1.75	1.8	1.9	2.1
12	3.1	3.45	3.45	2.5	1.7	1.4	3.25	2.5	1.75	1.75	1.9	2.1
13	3.2	3.3	3.3	2.4	1.7	1.4	2.9	2.55	1.75	1.75	1.95	2.05
14	3.1	2.94	3.1	2.4	1.75	1.35	2.85	2.5	1.8	1.8	1.95	2.05
15	3.3	3.1	3.11	2.3	1.75	1.35	2.8	2.45	1.75	1.8	1.9	2.1
16	3.4	3.3	3.0	2.3	1.73	1.35	3.1	2.4	1.7	1.8	1.9	2.1
17	3.2	3.4	3.0	2.25	1.72	1.35	3.3	2.35	1.75	1.75	1.9	2.1
18	3.2	3.35	3.0	2.2	1.73	1.3	3.35	2.3	1.75	1.75	1.9	2.1
19	3.2	3.4	2.8	2.25	1.73	1.1	3.35	2.2	1.7	1.8	1.9	2.05
20	3.2	3.1	2.8	2.2	1.73	1.1	2.8	2.2	1.75	1.8	1.9	2.1
21	3.2	3.75	2.9	2.2	1.73	1.2	2.7	2.25	1.75	1.8	1.95	2.1
22	3.0	3.5	2.7	2.1	1.73	1.0	2.75	2.25	1.75	1.85	1.95	2.15
23	2.8	3.0	2.75	2.5	1.7	1.0	2.85	2.3	1.7	1.85	1.95	2.2
24	2.8	2.95	2.7	2.5	1.7	1.0	2.7	2.3	1.7	1.85	1.95	2.25
25	2.9	2.93	2.7	2.1	1.65	1.0	2.75	2.25	1.7	1.85	1.95	2.3
26	2.9	3.75	2.65	2.0	1.65	1.0	2.8	2.2	1.75	1.9	2.0	2.[illegible]
27	2.8	3.7	2.7	2.0	1.6	1.0	2.7	2.1	1.75	1.9	2.0	2.35
28	2.8	3.5	2.7	2.0	1.65	1.0	2.85	2.0	1.75	1.9	2.05	2.35
29	2.9	.....	2.54	2.0	1.65	1.0	2.95	1.9	1.75	1.9	2.05	2.4
30	3.0	.....	2.51	1.8	1.65	1.0	2.8	1.9	1.75	1.85	2.05	2.4
31	2.9	.....	2.6	.....	1.6	.....	2.75	1.9	.....	1.85	.....	2.4

NOTE.—Ice conditions January 1 to February 19. Water stood in pools June 22 to July 3.

Station rating table for Humboldt River near Oreana, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	0.0	1.90	29.0	2.70	152.0	3.50	335.0
1.20	.5	2.00	40.0	2.80	172.0	3.60	360.0
1.30	1.0	2.10	53.0	2.90	193.0	3.70	385.0
1.40	2.0	2.20	67.0	3.00	215.0	3.80	412.0
1.50	3.5	2.30	82.0	3.10	238.0	3.90	440.0
1.60	7.0	2.40	98.0	3.20	261.0		
1.70	12.0	2.50	115.0	3.30	285.0		
1.80	20.0	2.60	133.0	3.40	310.0		

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is fairly well defined between gage heights 1.6 feet and 3 feet. It is only approximate below gage height 1.6 feet.

Estimated monthly discharge of Humboldt River near Oreana, Nev., for 1905.

[Drainage area, 13,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	440	172	260	15,990	0.019	.022
February	398	152	252	14,000	.018	.019
March	398	117	209	12,850	.015	.017
April	152	20	96.0	5,712	.0070	.0078
May	34	7	13.2	812	.00096	.0011
June	7	0	1.94	115	.00014	.00016
July	322	0	156	9,592	.011	.013
August	162	29	95.3	5,860	.0069	.0080
September	24	12	17.3	1,029	.0013	.0014
October	29	12	20.0	1,230	.0014	.0016
November	46	29	33.1	1,970	.0024	.0027
December	98	46	62.7	3,855	.0045	.0052
The year	440	0	101	73,020	.0073	.099

NOTE.—Ice conditions January 1 to February 19. Open-channel rating table applied to the winter months without correction. Winter estimates liable to considerable error.

SIERRA NEVADA DRAINAGE.

PRINCIPAL STREAMS.

The Sierra Nevada drainage area includes the western part of Nevada, the eastern part of California, and a small part of south-central Oregon. The principal rivers of the area, with the bodies of water into which they discharge, are the following: Truckee River into Pyramid and Winnemucca lakes, Walker River into Walker Lake, Carson River into Carson Sink, Susan River into Honey Lake, and Owens River into Owens Lake.

TRUCKEE RIVER BASIN.

DESCRIPTION OF BASIN.

Upper Truckee River rises on the eastern slopes of the Sierra Nevada, in Eldorado County, Cal., and flows northward, entering Lake Tahoe from the south. The main Truckee leaves the lake, of which it forms the outlet, at the town of Tahoe, in eastern Placer County, Cal., flows north and northeast, and discharges, in Washoe County, Nev., into Pyramid and Winnemucca lakes, which have no outflowing streams. The drainage basin is wild and mountainous, the highest peaks reaching altitudes exceeding 10,000 feet. Lake Tahoe, which lies at an elevation of 6,225 feet above sea, has an area of 193 square miles and is the largest body of fresh water in the United States at this altitude.

In the lower part of its course the Truckee receives several important tributaries, among which may be mentioned Donner and Prosser creeks and Little Truckee River, the latter uniting with the main stream at the town of Boca. Independence Creek is a branch of the Little Truckee.

TRUCKEE RIVER NEAR WADSWORTH, NEV.

This station was established November 6, 1902. It is located one-fourth mile west of the school at the Indian agency and is 18 miles north of Wadsworth, Nev.

The channel is straight for 200 feet above and below the cable. The right bank is low and is liable to overflow beyond the cable support at very high water; the left bank is high and will not overflow. The bed of the stream is composed of sand and gravel and is permanent. There is but one channel at all stages. The current is swift.

Discharge measurements are made by means of a cable and car about 200 feet below the gage. The initial point for soundings is the zero of the tagged wire.

The gage, which was read during 1905 twice each day by Edward C. Wood, is a 4 by 4 inch vertical timber spiked to a cottonwood tree on the right bank. The bench mark consists of three nails driven into the root of a cottonwood tree 18 feet north of the gage: elevation above gage zero, 12.07 feet. The gage was disturbed by a flood early in February, 1904, and settled 0.31 foot, so that the elevation of the bench mark is 12.38 feet above the zero of the present gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 188; 133, pp 298-299.
Discharge: 100, p 188; 133, p 299.
Discharge, monthly: 100, p 190; 133, p 300.
Gage heights: 100, pp 188-189; 133, p 299.
Rating table: 100, p 189; 133, p 300.

Discharge measurements of Truckee River near Wadsworth, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 18	W. A. Wolf	124	528	2.48	6.42	1,314
June 8	do	127	418	2.15	5.85	89[illegible]
July 11	do	120	254	1.26	4.58	[illegible]21

Daily gage height, in feet, of Truckee River near Wadsworth, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.3	5.38	6.35	5.52	6.65	6.38	4.85	3.85	4.05	4.77	5.1	4.97
2	6.1	5.57	6.38	5.6	6.55	6.4	4.82	3.82	4.1	4.7	5.02	5.0
3	6.0	5.6	6.4	5.6	6.58	6.3	4.78	3.82	4.1	4.65	5.0	5.05
4	6.0	5.7	6.4	5.8	6.75	6.22	4.65	3.8	4.07	4.52	4.9	5.07
5	6.0	5.65	6.4	5.8	6.4	6.15	4.8	3.8	4.05	4.6	4.9	5.07
6	6.0	5.65	6.48	5.88	6.35	5.98	4.82	3.8	4.25	4.4	4.8	4.9
7	5.9	5.4	6.5	6.0	6.2	5.92	4.75	3.9	4.22	4.65	4.82	4.95
8	5.85	5.35	6.55	6.0	6.2	5.89	4.64	3.8	4.25	4.75	4.82	4.9
9	5.85	5.3	6.58	6.0	6.2	5.85	4.64	3.8	4.4	4.87	4.75	4.82
10	5.85	5.38	6.55	6.1	6.25	5.82	4.52	3.8	4.4	4.95	4.7	4.8
11	5.85	5.55	6.48	6.18	6.02	6.08	4.52	3.8	4.4	5.0	4.72	4.77
12	5.98	5.48	6.5	5.98	5.95	6.15	4.4	3.8	4.3	5.0	4.7	4.77
13	5.9	5.4	6.48	5.82	5.9	6.4	4.36	3.8	4.3	5.12	4.72	4.87
14	5.9	5.4	6.58	5.78	5.95	6.18	4.35	4.05	4.25	5.02	4.7	4.97
15	5.9	5.6	6.5	5.7	6.05	6.12	4.4	4.0	4.25	5.05	4.6	5.0
16	5.55	5.5	6.35	5.7	6.22	6.1	4.36	4.0	4.25	5.27	4.6	5.0
17	5.5	5.5	6.0	5.65	6.5	6.0	4.22	3.95	4.15	5.25	4.62	4.85
18	5.4	5.55	6.0	5.65	6.95	6.12	4.1	3.95	4.17	5.2	4.92	4.7
19	5.32	5.55	6.0	5.65	6.8	5.92	4.1	4.0	4.17	5.25	5.0	4.72
20	5.3	5.58	6.0	5.52	6.7	5.95	4.0	4.0	4.2	5.1	5.07	4.67
21	5.3	6.0	6.0	5.3	6.7	5.85	3.98	4.0	4.2	5.2	5.22	4.85
22	5.55	5.85	6.0	5.2	6.82	5.85	3.98	4.05	4.4	4.92	5.0	5.1
23	5.68	6.02	5.7	5.18	6.6	5.7	3.95	4.18	4.34	5.0	5.0	4.65
24	5.6	6.05	5.65	5.25	6.12	5.58	4.0	4.25	4.22	4.95	5.12	4.7
25	5.55	6.2	5.7	5.35	6.5	5.45	3.9	4.25	4.4	4.9	5.2	4.77
26	5.42	6.3	5.65	5.84	6.5	5.32	3.88	4.25	4.51	5.05	5.0	4.9
27	5.4	6.35	6.1	7.12	6.68	5.15	3.9	4.2	4.4	5.1	5.0	4.97
28	5.4	6.38	6.0	6.8	6.45	5.1	3.9	4.12	4.52	5.1	5.02	5.0
29	5.38	.....	5.88	6.68	6.6	4.92	3.88	4.0	4.52	5.05	4.95	5.0
30	5.3	.....	5.78	6.7	6.52	4.82	3.85	4.07	4.5	5.05	4.95	4.85
31	5.3	.....	5.55	.....	6.5	.....	3.85	4.05	.....	4.95	.....	4.92

Station rating table for Truckee River near Wadsworth, Nev., from January 1 to December 31, 1905.

Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.80	108	4.70	358	5.60	770	6.50	1,350
3.90	131	4.80	394	5.70	825	6.60	1,430
4.00	155	4.90	432	5.80	885	6.70	1,510
4.10	180	5.00	472	5.90	945	6.80	1,595
4.20	206	5.10	515	6.00	1,005	6.90	1,685
4.30	233	5.20	560	6.10	1,070	7.00	1,775
4.40	262	5.30	610	6.20	1,135	7.10	1,865
4.50	292	5.40	660	6.30	1,205	7.20	1,955
4.60	324	5.50	715	6.40	1,275		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 4.6 feet and 8 feet.

Estimated monthly discharge of Truckee River near Wadsworth, Nev., for 1905.

[Drainage area, 2,130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,205	610	826	50,790	0.388	0.447
February	1,261	610	827	45,930	.388	.404
March	1,414	742	1,133	69,670	.532	.6[illegible]
April	1,883	551	935	55,640	.439	.490
May	1,730	945	1,306	80,300	.613	.7[illegible]
June	1,275	402	935	55,640	.439	.490
July	413	120	241	14,820	.113	.13[illegible]
August	220	108	148	9,100	.069	.0[illegible]
September	298	168	229	13,630	.108	.12[illegible]
October	595	262	457	28,100	.215	.246
November	570	324	434	25,820	.204	.228
December	515	341	433	26,620	.203	.234
The year	1,883	108	659	476,100	.309	4.19

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

TRUCKEE RIVER AT VISTA, NEV.

This station was established August 18, 1899. It is located 7 miles east of Reno, Nev., and one-fourth mile from the Southern Pacific Railroad station at Vista.

The channel is straight for 150 feet above and 400 feet below the station. Both banks are high; the left is liable to overflow at extreme high stages only. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car below the railroad bridge. The initial point for soundings is the zero of the tagged wire.

During 1905 the gage was read once each day by Patrick Fay. The original gage was replaced November 12, 1902, by a new gage, which was installed on the left bank 150 feet above the railroad bridge, its zero having the same elevation as that of the original gage. April 3, 1903, another new gage was established, consisting of a 4 by 4 inch vertical timber located on the left bank and having the same datum as the previous gages. June 23, 1903, this gage was torn out and moved 3 feet farther into the river, in order to place it in deeper water, and the zero of the gage was lowered 2.72 feet. The bench mark is the head of a bolt set in the concrete of the upstream side of the left abutment of the Southern Pacific Railroad bridge, 300 feet from the gage; elevation above zero of gage, 19.74 feet. February 21, 1904, the gage rod was washed out by a flood. A new gage was established in the same position as the old gage, but with its zero 1.54 feet above that of the old gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 38, pp 331-332; 51, p 404; 66, p 113; 85, pp 117-118; 100, pp 185-186; 133, p 301.
Discharge: WS 38, p 332; 51, p 404; 66, p 113; 85, p 118; 100, p 186; 133, pp 301-302.
Discharge, monthly: Ann 11, ii, p 102; 12, ii, p 351; 13, iii, p 95; 22, iv, p 405; WS 75, p 186; 85, p 119; 100, p 187; 133, p 303.
Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 59.
Gage heights: WS 38, p 332; 51, p 405; 66, p 114; 85, p 118; 100, pp 186-187; 133, p 302.
Hydrographs: Ann 12, ii, p 324; 22, iv, p 405; WS 75, p 186.
Rating tables: WS 52, p 521; 66, p 175; 85, p 119; 100, p 187; 133, p 303.

Discharge measurements of Truckee River at Vista, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 6	W. A. Wolf	117	518	1.98	5.25	1,027
April 13	do	115	480	1.70	5.00	816
April 28	do	117	593	2.86	6.28	1,698
May 25	do	117	563	2.45	5.85	1,381
June 14	do	118	510	1.98	5.30	1,009
June 22	do	114	368	1.04	4.07	381
July 5	do	114	368	1.07	4.10	394
July 17	do	113	327	.70	3.55	221
September 16	do	113	337	.79	3.70	266

Daily gage height, in feet, of Truckee River at Vista, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.6	4.8	5.8	.....	5.6	5.7	4.1	3.4	3.4	4.0	4.3	4.3
2	5.4	5.1	5.8	5.0	5.8	5.6	4.1	3.4	3.5	4.0	4.3	4.4
3	5.4	5.9	5.9	5.0	6.0	5.4	4.1	3.4	3.5	4.0	4.1	4.4
4	5.4	4.8	5.9	4.9	6.2	5.7	4.1	3.4	3.5	4.0	4.1	4.4
5	5.3	4.8	6.0	5.3	5.8	5.6	4.1	3.4	3.5	4.0	4.1	4.4
6	5.3	4.8	6.0	5.4	5.6	5.3	4.1	3.4	3.6	4.0	4.2	4.4
7	5.2	4.8	6.0	5.5	5.5	5.3	4.0	3.4	3.6	4.1	4.2	4.4
8	5.2	4.8	6.0	5.5	5.5	5.2	3.9	3.4	3.7	4.1	4.2	4.4
9	5.2	4.7	6.0	5.3	5.5	5.3	3.9	3.4	3.7	4.1	4.2	4.4
10	5.1	4.9	5.8	5.5	5.5	5.6	3.8	3.4	3.7	4.1	4.2	4.0
11	5.1	4.8	5.9	5.4	5.3	5.3	3.7	3.4	3.7	4.2	4.3	4.2
12	5.1	4.8	5.9	5.2	5.2	5.5	3.7	3.4	3.7	4.2	4.3	4.1
13	5.0	4.8	6.1	5.0	5.0	5.6	3.7	3.4	3.7	4.2	4.3	4.1
14	5.0	4.9	6.0	5.0	4.8	5.6	3.5	3.4	3.7	4.2	4.3	4.2
15	5.0	4.9	5.8	5.1	5.6	5.4	3.5	3.5	3.7	4.2	4.2	4.1
16	4.9	5.0	5.5	5.0	5.7	5.4	3.5	3.5	3.7	4.2	4.2	4.1
17	5.8	4.9	5.5	4.9	5.3	5.3	3.4	3.5	3.7	4.2	4.2	4.1
18	4.8	4.9	5.5	4.8	5.4	5.3	3.4	3.6	3.7	4.2	4.2	4.1
19	4.7	5.0	5.5	4.8	6.3	5.3	3.4	3.6	3.7	4.2	4.2	4.1
20	4.8	5.5	5.5	4.9	6.2	5.0	3.4	3.6	3.7	4.2	4.3	4.1
21	5.2	5.3	5.5	5.0	6.2	5.0	3.4	3.6	3.7	4.2	4.3	4.0
22	5.3	5.4	5.5	4.5	6.0	4.8	3.4	3.7	3.7	4.2	4.4	3.7
23	5.0	5.4	5.3	4.7	5.8	4.8	3.4	3.7	3.8	4.2	4.4	3.7
24	5.0	5.9	5.3	4.5	5.7	4.4	3.4	3.7	3.8	4.3	4.3	3.1
25	4.9	5.8	5.0	4.5	6.0	4.6	3.2	3.7	3.9	4.3	4.2	3.9
26	4.8	5.8	5.0	6.0	5.9	4.6	3.2	3.7	3.9	4.3	4.2	4.2
27	4.8	5.8	5.5	6.5	5.7	4.4	3.3	3.7	3.9	4.2	4.2	4.1
28	4.7	5.8	5.4	6.3	5.8	4.2	3.4	3.6	3.9	4.2	4.2	4.1
29	4.8	.....	5.4	6.2	5.7	4.0	3.4	3.6	4.0	4.2	4.2	4.1
30	4.7	.....	4.9	6.2	5.7	4.0	3.4	3.5	4.0	4.2	4.3	4.1
31	4.7	.....	.....	.....	5.8	.....	3.4	3.5	.....	4.3	.....	4.1

Station rating table for Truckee River at Vista, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.20	150	4.10	405	5.00	850	5.80	1,350
3.30	171	4.20	445	5.10	910	5.90	1,420
3.40	195	4.30	485	5.20	970	6.00	1,490
3.50	220	4.40	525	5.30	1,030	6.10	1,560
3.60	245	4.50	570	5.40	1,090	6.20	1,635
3.70	275	4.60	620	5.50	1,155	6.30	1.710
3.80	305	4.70	675	5.60	1,220	6.40	1,785
3.90	335	4.80	730	5.70	1,285	6.50	1,860
4.00	370	4.90	790				

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 3.5 feet and 6.3 feet.

Estimated monthly discharge of Truckee River at Vista, Nev., for 1905.

[Drainage area, 1,519 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,220	675	894	54,970	0.589	0.679
February	1,420	675	943	52,370	.621	.647
March	1,560	790	1,237	76,060	.814	.938
April	1,860	570	1,003	59,680	.660	.736
May	1,710	730	1,279	78,640	.842	.972
June	1,285	370	930	55,340	.612	.683
July	405	150	260	15,990	.171	.197
August	275	195	224	13,770	.147	.170
September	370	195	279	16,600	.184	.205
October	485	370	430	26,440	.283	.326
November	525	405	460	27,370	.303	.338
December	525	130	421	25,890	.277	.319
The year	1,860	130	697	503,100	.459	6.21

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

TRUCKEE RIVER AT NEVADA-CALIFORNIA STATE LINE.

This station was established September 7, 1899. It is located at the State line, 17 miles west of Reno, Nev.

The channel is straight for 60 feet above and 75 feet below the cable. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of bowlders and cobblestones. The current is swift.

Discharge measurements are made by means of a cable and car, 2½ miles below the gage at Linham Siding and 100 feet below bridge No. 2. The initial point for soundings is the zero of the tagged wire.

The gage was read once each day during 1905 by H. E. Dickinson. The original gage was vertical, driven into the bed of the river and wired to a granite bowlder. November 11, 1902, a new gage was established on the right bank, 400 feet below the point at which the old gage was located. The new gage consists of two sections of 4 by 4 inch timber. The upper section is vertical and is spiked to a cottonwood tree; the lower section is inclined and is immediately under the vertical section. The gage datum is the same as that of the old gage. The bench mark consists of two spikes driven into the root of the cottonwood tree to which the vertical section of the gage is attached; elevation above zero of gage, 5.99 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 38, p 331; 51, p 403; 66, p 112; 85, pp 119-120; 100, pp 192-193; 133, p 304.
Discharge: WS 38, p 331; 51, p 403; 66, p 112; 85, p 120; 100, p 193; 133, p 304.
Discharge, monthly: Ann 22, iv, p 404; WS 75, p 185; 85, p 121; 100, p 194; 133, p 306.
Gage heights: WS 38, p 331; 51, p 404; 66, p 113; 85, p 120; 100, pp 193-194; 133, p 305.
Hydrograph: Ann 22, iv, p 404.
Rating tables: WS 52, p 521; 66, p 175; 85, p 120; 100, p 194; 133, p 306.

Discharge measurements of Truckee River at Nevada-California State line in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 17	W. A. Wolf	80	344	2.76	2.85	949
May 13	do	80	370	2.91	2.95	1,078
May 26	do	87	441	4.00	3.65	1,761
June 6	do	81	378	3.10	3.08	1,170
June 21	do	80	340	2.66	2.80	905
July 10	do	80	300	1.93	2.25	580
July 18	do	76	277	1.97	2.15	544
July 25	do	76	277	1.95	2.12	539
September 13	do	74	274	1.52	1.97	416

Daily gage height, in feet, of Truckee River at Nevada-California State line for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.3	3.3	2.4	3.45	3.3	2.3	2.0	2.05	2.02	2.02	1.95
2	2.8	2.3	3.3	.....	3.35	3.25	2.35	2.07	2.1	2.02	1.9	1.9
3	2.8	2.3	3.3	2.6	3.25	3.25	2.35	2.1	2.05	2.05	1.95	1.87
4	2.8	2.3	3.3	2.6	3.2	3.08	2.32	2.07	2.1	2.05	2.0	1.9
5	2.7	2.28	3.3	2.7	3.15	3.05	2.35	2.5	2.1	2.05	1.95	1.8
6	2.7	2.3	3.3	2.85	3.08	3.25	2.32	2.15	2.05	2.15	1.97	1.8
7	2.7	2.3	3.3	2.9	3.3	3.05	2.3	2.1	2.1	2.1	1.85	1.9
8	.....	2.3	3.3	2.88	3.05	3.05	2.3	2.1	2.1	2.05	1.9	1.9
9	2.65	2.3	3.3	.....	3.0	3.05	2.25	2.1	2.1	2.1	1.95	1.9
10	2.7	2.35	3.2	3.25	2.95	3.35	2.2	2.1	2.1	2.1	1.95	1.9
11	2.6	2.3	3.2	2.85	2.95	3.3	2.2	2.1	2.05	2.2	1.95	1.9
12	2.6	2.35	3.2	2.8	2.9	3.3	2.1	2.18	2.05	2.15	1.87	1.85
13	2.6	2.25	3.2	2.8	2.9	3.25	2.1	2.15	2.05	2.1	1.95	1.92
14	2.2	2.25	3.25	2.8	2.98	3.17	2.25	2.1	2.05	2.1	1.7	1.87
15	2.4	2.3	3.25	2.85	3.45	3.2	2.25	2.1	2.02	2.05	1.7	1.97
16	2.4	2.35	2.7	2.85	3.65	.....	2.25	2.12	2.0	2.05	1.85	1.87
17	2.2	2.4	2.7	2.85	3.95	3.22	2.18	2.1	2.05	2.05	1.98	1.9
18	2.2	2.47	2.75	2.85	3.7	3.08	2.15	2.15	2.05	2.05	1.97	1.77
19	2.2	2.4	2.75	2.82	3.75	3.05	2.15	2.1	2.15	2.05	1.8	1.8
20	2.2	2.65	2.78	.....	3.75	3.0	2.02	2.1	2.1	2.05	1.95	1.8
21	2.6	2.45	2.8	2.65	3.7	2.8	2.15	2.15	2.05	2.1	1.97	1.7
22	2.7	2.85	2.8	2.65	3.7	2.8	2.15	2.15	2.05	2.05	2.0	1.7
23	2.5	2.62	2.6	2.7	3.65	2.75	2.15	2.12	2.05	2.05	1.97	1.8
24	2.5	3.02	2.45	2.9	3.65	2.6	2.15	2.1	2.05	2.2	2.0	1.8
25	2.32	3.02	2.4	3.1	3.5	2.6	2.1	2.1	2.05	2.0	1.95	1.8
26	2.32	3.08	2.95	4.02	3.4	2.5	2.1	2.02	2.05	2.02	1.9	1.82
27	2.3	3.12	2.95	3.8	3.3	2.45	2.1	2.05	2.05	2.0	1.85	1.82
28	2.5	3.05	2.5	3.8	3.35	2.4	2.1	2.1	2.05	2.02	1.9	1.8
29	.....	.....	2.3	3.72	3.38	2.38	2.1	2.05	2.05	2.02	1.95	1.82
30	2.4	.....	2.4	.....	3.4	2.35	2.1	2.1	2.05	2.0	1.95	1.78
31	2.3	.....	2.4	.....	3.3	.....	2.0	2.02	.....	2.5	.....	1.75

Station rating table for Truckee River at Nevada-California State line from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	300	2.30	610	2.90	1,042	3.50	1,580
1.80	346	2.40	673	3.00	1,126	3.60	1,676
1.90	394	2.50	740	3.10	1,213	3.70	1,772
2.00	444	2.60	810	3.20	1,302	3.80	1,870
2.10	496	2.70	884	3.30	1,393	3.90	1,970
2.20	551	2.80	961	3.40	1,486	4.00	2,070

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined. Above gage height 3 feet it is the same as 1904 table.

Estimated monthly discharge of Truckee River at Nevada-California State line for 1905.

[Drainage area, 955 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	961	551	755	46,420	0.791	0.912
February	1,228	580	754	41,880	.789	.822
March	1,393	610	1,096	67,390	1.15	1.33
April	2,090	673	1,114	66,290	1.17	1.30
May	2,020	1,042	1,453	89,340	1.52	1.75
June	1,439	642	1,115	66,350	1.17	1.30
July	642	444	548	33,700	.574	.662
August	540	444	503	30,930	.527	.608
September	524	444	477	28,380	.499	.557
October	551	444	487	29,940	.510	.588
November	454	300	405	24,100	.424	.473
December	429	300	366	22,500	.383	.442
The year	2,090	300	756	547,900	.792	10.74

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction. Discharge interpolated on days when gage was not read.

TRUCKEE RIVER AT TAHOE, CAL.

This station was established June 17, 1900, with a view to ascertaining the actual overflow from Lake Tahoe and the real value of the lake as a storage reservoir. It is located at the city of Tahoe. About 500 feet from the lake there is a timber dam across the river, which has been maintained for more than twenty years for the purpose of controlling the discharge from the lake.

The channel is nearly straight for 300 feet above and below the station. At the point of measurement the right bank is low and is subject to overflow at very high stages of the stream; the left bank is rather high. The bed of the stream, which is of gravel and coarse sand, is smooth and stable. The current has a moderate velocity.

Discharge measurements are made from a cable and suspended car about one-fourth mile below the gage. In June, 1904, a new cable was put in 1 mile below the gage.

The gage, which is read once each day by J. U. Haley, is located about 300 feet below the dam, as near the city of Tahoe as possible, for the convenience of the observer. It consists of a vertical timber driven into the stream bed and spiked to the root of a cottonwood tree growing on the bank. November 18, 1902, a new gage was established in the exact position of the old gage and with its zero at the same elevation. It is a 4 by 4

inch vertical timber. The bench mark is cut in the side of the tree and is 4.00 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 140, pp 210-211; WS 51, p 402; 66, p 111; 85, pp 115-116; 100, p 183; 133, p 307.
Discharge: Ann 11, ii, pp 64, 108; WS 51, p 402; 66, p 111; 85, p 116; 100, p 183; 133, p 307.
Discharge, monthly: Ann 22, iv, p 403; Bull 140, p 212; WS 75, p 184; 85, p 117; 100, p 185; 133, p 309.
Gage heights: Bull 140, p 211; WS 51, p 403; 66, p 112; 85, p 116; 100, p 184; 133, p 308.
Hydrograph: Ann 22, iv, p 403.
Rating tables: WS 52, p 520; 66, p 175; 85, p 117; 100, p 184; 133, p 308.

Discharge measurements of Truckee River at Tahoe, Cal., in 1905.

Date	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	W. A. Wolf	20	15.2	1.01	0.30	15.4
May 24	do	73	126	1.61	1.27	203
June 13	do	72	125	1.61	1.30	211
June 19	do	72	125	1.60	1.30	205
July 26	do	79	168	1.95	1.80	328

Daily gage height, in feet, of Truckee River at Tahoe, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	a 2.7	b 1.6	a 2.55	0.4	0.3	1.3	1.45	1.9	2.0	2.0	1.8	1.7
2	a 2.7	b 1.6	a 2.55	.4	.3	1.3	1.45	2.0	2.0	2.0	1.8	1.7
3	a 2.7	b 1.65	a 2.55	.4	.3	1.3	1.45	2.0	2.0	2.0	1.8	1.7
4	a 2.7	b 1.65	a 2.5	.4	.7	1.3	1.5	2.0	2.0	2.1	1.8	1.7
5	a 2.7	b 1.65	a 2.5	.4	1.0	1.3	1.5	2.0	2.0	2.1	1.7	1.7
6	a 2.6	c 1.65	a 2.5	.4	1.0	1.3	1.5	2.0	2.0	2.1	1.7	1.7
7	a 2.6	c 2.0	a 2.5	.4	1.25	1.3	1.5	2.0	2.0	2.1	1.7	1.7
8	a 2.6	c 2.0	a 2.5	.4	1.25	1.3	1.5	2.0	2.0	2.1	1.7	1.7
9	a 2.6	c 2.0	a 2.5	.4	1.25	1.3	1.5	1.95	2.0	2.1	1.7	1.6
10	a 2.6	c 2.0	a 2.5	.4	1.25	1.3	1.5	2.0	2.0	2.1	1.7	1.6
11	b 1.6	c 2.0	a 2.5	.4	1.25	1.3	1.5	2.0	1.9	2.1	1.7	1.6
12	b 1.6	c 2.0	2.5	.3	1.25	1.3	1.5	2.0	1.9	2.1	1.7	1.6
13	b 1.6	c 2.0	2.5	.3	1.25	1.3	1.6	2.0	1.9	2.0	1.7	1.6
14	b 1.6	c 2.0	2.5	.3	1.25	1.3	1.6	2.0	1.9	2.0	1.7	1.6
15	b 1.6	c 2.0	1.6	.3	1.25	1.3	1.6	2.0	1.9	2.0	1.7	1.6
16	b 1.6	c 2.0	1.6	.3	1.25	1.3	1.6	2.0	1.9	2.0	1.7	1.6
17	b 1.6	c 2.0	1.6	.3	1.25	1.3	1.6	2.0	1.9	2.0	1.7	1.5
18	b 1.6	c 2.0	1.6	.3	1.25	1.3	1.6	2.0	2.0	2.0	1.7	1.5
19	b 2.5	a 2.55	1.6	.3	1.25	1.3	1.9	2.0	2.0	2.0	1.7	1.5
20	b 2.5	a 2.55	1.15	.3	1.25	1.3	1.9	2.0	2.0	2.0	1.7	1.5
21	b 2.5	a 2.55	1.15	.3	1.25	1.3	1.9	2.0	2.0	2.0	1.7	1.5
22	b 1.6	a 2.55	1.15	.3	1.25	1.3	1.9	2.0	2.0	1.9	1.7	1.5
23	b 1.6	a 2.55	.4	.3	1.3	1.3	1.9	2.0	2.0	1.9	1.7	1.5
24	b 1.6	a 2.55	.4	.3	1.3	1.35	1.9	2.0	2.0	1.9	1.7	1.5
25	b 1.6	a 2.55	.4	.3	1.3	1.35	1.9	2.0	2.0	1.9	1.7	1.5
26	b 1.6	a 2.55	.4	.3	1.3	1.45	1.9	2.0	2.0	1.9	1.6	1.5
27	b 1.6	a 2.55	.4	.3	1.3	1.45	1.9	2.0	2.0	1.9	1.6	1.5
28	b 1.6	a 2.55	.4	.3	1.3	1.45	1.9	2.0	2.0	1.9	1.6	1.5
29	b 1.6	.....	.4	.3	1.3	1.45	1.9	2.0	2.0	1.9	1.6	1.4
30	b 1.6	.....	.4	.3	1.3	1.45	1.9	2.0	2.0	1.9	1.6	1.4
31	b 1.6	.....	.4	.....	1.3	.....	1.9	2.0	.....	1.8	.....	1.4

a All gates up. b One gate up. c Two gates up.

Station rating table for Truckee River at Tahoe, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	15	1.00	139	1.60	279	2.20	453
0.40	31	1.10	160	1.70	306	2.30	485
0.50	47	1.20	182	1.80	334	2.40	518
0.60	64	1.30	205	1.90	363	2.50	552
0.70	82	1.40	229	2.00	392	2.60	586
0.80	100	1.50	253	2.10	422	2.70	622
0.90	119						

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 and the form of previous curves. It is not well defined.

Estimated monthly discharge of Truckee River at Tahoe, Cal., for 1905.

[Drainage area, 519 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	622	279	410	25,210	0.790	0.911
February	569	279	433	24,050	.834	.968
March	569	31	321	19,740	.618	.712
April	31	15	20.9	1,244	.040	.045
May	205	15	173	10,640	.333	.384
June	241	205	212	12,620	.408	.455
July	363	241	303	18,630	.584	.673
August	392	363	391	24,040	.753	.868
September	392	363	385	22,910	.742	.828
October	422	334	390	23,980	.751	.866
November	334	279	305	18,150	.588	.656
December	306	229	271	16,660	.522	.602
The year	622	15	301	217,900	.580	7.87

NOTE.—Ice conditions not known. Open-channel rating table applied to the winter months without correction.

LAKE WINNEMUCCA INLET NEAR WADSWORTH, NEV.

This station was established November 7, 1902. It is located 3 miles north of Pyramid Lake Indian School and 21 miles north of Wadsworth, Nev.

The channel is straight for 150 feet above and below the cable. Both banks are high and not subject to overflow. The bed is composed of gravel and silt and may change slightly. There is but one channel at all stages. The current is moderate.

Discharge measurements are made by means of a cable and car near the gage. The initial point for soundings is the zero of the tagged wire.

The gage, which was read three times each day during 1905 by Edward C. Wood, is a 4 by 4 inch vertical timber spiked to a willow tree on the right bank. The bench mark consists of two spikes driven into the tree to which the gage is attached; elevation above zero of gage, 6.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 190; 133, p 309.
Discharge: 100, p 191; 133, p 310.
Discharge, monthly: 100, p 192; 133, p 311.
Gage heights: 100, p 191; 133, p 310.
Rating table. 100, p 192; 133, p 311.

Discharge measurements of Lake Winnemucca Inlet near Wadsworth, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 18	W. A. Wolf	46	118	1.66	3.30	196
June 8	do	46	114	1.61	3.20	185
July 11	do	46	85	1.75	2.75	149

Daily gage height, in feet, of Lake Winnemucca Inlet near Wadsworth, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.88	2.21	2.27	2.21						2.2	2.1	
2	2.77			2.21		3.45	2.45	2.65	2.35			1.95
3			2.27		3.15				2.35			1.9
4	2.66	2.29				3.25	2.35			2.2	2.1	
5		2.27		2.23				2.55			2.0	
6	2.66		2.3		3.1			2.6	2.3	2.15		
7					3.08	3.12						1.8
8		2.24		2.24		3.1	2.32	2.65		2.2	1.9	
9	2.21		2.29	2.24			2.6		2.3			1.8
10					3.1	3.0		2.65	2.3		1.8	1.8
11	2.21	2.21	2.28			2.3				2.3	1.75	
12			2.28	2.24			2.05	2.65			1.75	
13	2.22				3.05			2.7	2.25			1.85
14					3.05	2.15				2.3		
15	2.0			2.22			2.75	2.75		2.2		
16	2.0	2.24	2.26	2.2			2.75		2.3		1.8	1.8
17					3.2	2.15		2.7	2.3			2.2
18	2.0	2.25	2.2			2.2				2.25	1.85	
19	2.22	2.24	2.24	2.18			2.7	2.75			1.9	
20	1.19				3.25			2.5	2.25			2.1
21					3.25	2.1				2.2		
22	1.19	2.26	2.24	2.17			2.68			2.2	1.9	
23				2.19			2.6	2.6	2.2			2.1
24					3.15	2.05			2.2			2.0
25	2.0	2.29	2.2	2.36		2.9				2.15	1.95	
26		2.25	2.22				2.6	2.6				
27	2.0			2.58	3.5			2.5	2.3			2.0
28	2.0				3.45	2.65				2.1		
29			2.23	2.55			2.58			2.15	1.9	
30	2.0			3.2		2.55	2.6	2.5	2.2			2.1
31					3.45							

Station rating table for Lake Winnemucca Inlet near Wadsworth, Nev., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	27	1.80	67	2.40	116	3.00	170
1.30	33	1.90	75	2.50	125	3.10	179
1.40	39	2.00	83	2.60	134	3.20	188
1.50	46	2.10	91	2.70	143	3.30	197
1.60	53	2.20	99	2.80	152	3.40	206
1.70	60	2.30	107	2.90	161	3.50	216

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905 and the form of previous curves. It is not well defined.

Estimated monthly discharge of Lake Winnemucca Inlet near Wadsworth, Nev., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
January	159	26	93.9	5,774
February	106	100	103	5,7[illegible]
March	107	99	103	6,3[illegible]
April	188	97	107	6,3[illegible]
May	216	174	189	11,[illegible]
June	211	87	136	8,093
July	148	109	132	8,116
August	148	121	135	8,3[illegible]1
September	116	99	105	6,24[illegible]
October	107	91	99.0	6,087
November	91	64	75.5	4,493
December	99	67	79.6	4,894
The year	216	26	113	82,04[illegible]

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction. Discharge interpolated on days when gage was not read.

LITTLE TRUCKEE RIVER AT PINE STATION, CAL.

Little Truckee River rises on the eastern slope of the Sierra Nevada Mountains, in northwestern Nevada County, Cal., flows north, then east, and then south, and unites with the Truckee at the town of Boca, Cal.

The station was established June 25, 1903. The cable station is located about one-fourth mile upstream from Bruhn's mill, known also as Pine station. The road which follows the Little Truckee north from Boca crosses the river at a ford about 150 feet below the cable and the same distance above the gage rod. Pine station, on the Boca and Loyalton Railroad, about one-fourth of a mile distant, is the nearest railroad point.

Above the station the channel is straight for 100 feet at high water and for 30 feet at low water; below the station it is straight for 200 feet at high and low water. The right (south) bank is high, steep, and rocky and is not subject to overflow. It supports some underbrush and a few trees. The left (north) bank is composed of gravel for 40 feet back from the high-water channel, is low, and may be overflowed. The bed of the stream consists of course gravel and is free from vegetation. There is but one channel at all stages. The current is swift.

Discharge measurements are made from a wooden car running on a three-eighth-inch steel cable which is stretched across the river about 5½ feet above the high-water level. A tag wire is stretched just above the cable. The initial point for sounding is the post which supports the cable on the left bank.

The gage, which is read twice each day by S. Wallace, is located about 300 feet below the cable, and consists of a vertical 2 by 6 inch board. The bench mark is the head of a large nail driven into a 2 by 4 inch timber set in the ground in a clump of small willows 8 feet from the gage; willows surrounding the bench mark are blazed and marked "B. M., U. S. G. S."; elevation of bench mark above zero of gage, 4.83 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p. 195; 133, p 312.
Discharge: 100, p 195; 133, p 313.
Discharge, monthly: 100, p 197; 133, p 314.
Gage heights: 100, p 196; 133, p 313.
Rating table: 100, p 196; 133, p 314.

Discharge measurements of Little Truckee River at Pine Station, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 16	W. A. Wolf	66	104	2.78	1.85	289
May 11	do	66	101	2.71	1.80	274
May 27	do	67	126	2.90	2.05	366
June 7	do	68	109	3.15	2.00	343
June 23	do	60	75	1.84	1.36	138
July 8	do	54	58	1.70	1.12	98
July 24	do	52	51	1.59	1.03	81

Daily gage height, in feet, of Little Truckee River at Pine Station, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.28	1.13	1.36	1.53	2.49	2.26	1.28	0.75	0.58	0.7	0.71	1.12
2	1.25	1.19	1.44	1.6	2.5	2.22	1.4	.75	.6	.7	.71	1.2
3	1.24	1.09	1.43	1.64	2.59	2.14	1.4	.73	.58	.7	.7	1.13
4	1.0	1.04	1.46	1.65	2.43	2.09	1.38	.73	.6	.7	.71	1.1
5	0.99	1.0	1.54	1.75	2.29	1.99	1.32	.72	.6	.68	.66	1.15
6	1.14	1.0	1.59	1.76	2.22	1.97	1.22	.7	.6	.68	.65	1.18
7	1.16	1.0	1.6	1.83	2.24	1.96	1.18	.7	.6	.68	.71	1.2
8	1.14	.82	1.62	1.84	2.15	2.04	1.18	.7	.6	.7	.69	1.13
9	1.06	.86	1.6	1.85	2.12	2.12	1.14	.68	.6	.7	.67	1.15
10	1.12	.94	1.59	1.84	1.99	2.16	1.12	.68	.61	.7	.67	1.13
11	1.1	1.02	1.6	1.78	1.95	2.21	1.1	.68	.6	.68	.71	1.26
12	1.06	.94	1.56	1.94	1.9	2.3	1.04	.7	.61	.68	.82	1.23
13	1.01	1.0	1.68	1.74	1.99	2.26	1.04	.7	.61	.68	.8	1.3
14	1.08	1.0	1.58	1.76	2.12	2.19	1.1	.7	.61	.68	.81	1.3
15	1.25	1.02	1.53	1.85	2.1	2.16	1.1	.68	.6	.68	.79	1.3
16	1.25	1.06	1.55	1.8	2.35	2.14	1.06	.65	.6	.69	.83	1.25
17	1.25	1.04	1.56	1.72	2.62	2.16	0.98	.65	.62	.67	.83	1.18
18	1.19	1.02	1.5	1.82	2.58	2.03	.93	.65	.63	.7	.81	1.23
19	1.12	1.1	1.52	1.7	2.5	1.99	.9	.64	.63	.69	.79	1.2
20	1.13	1.18	1.56	1.63	2.5	1.98	.9	.63	.63	.69	.81	1.2
21	1.06	1.05	1.56	1.62	2.52	1.93	.9	.66	.63	.69	.83	1.0
22	1.11	1.05	1.48	1.62	2.44	1.8	.86	.7	.63	.69	.9	1.2
23	1.26	1.06	1.51	1.69	2.25	1.76	.85	.7	.63	.69	.87	1.15
24	1.29	1.14	1.58	1.8	2.29	1.72	1.02	.65	.64	.69	.79	1.2
25	1.23	1.24	1.56	2.46	2.26	1.66	.9	.65	.65	.7	.74	1.25
26	1.3	1.28	1.82	2.74	2.36	1.65	.88	.63	.65	.7	.73	1.3
27	1.26	1.32	1.62	2.69	2.12	1.66	.82	.62	.65	.7	.83	1.25
28	1.14	1.38	1.54	2.72	2.24	1.34	.8	.6	.69	.7	1.0	1.12
29	1.13	.....	1.43	2.85	2.2	1.3	.8	.6	.7	.7	1.2	1.15
30	1.06	.....	1.52	2.59	2.22	1.28	.8	.6	.73	.7	1.12	.....
31	1.14	.....	1.49	.....	2.2	.....	.75	.58	.....	.7	.....	1.23

Station rating table for Little Truckee River at Pine Station, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	35	1.20	107	1.80	270	2.40	531
0.70	45	1.30	126	1.90	307	2.50	580
0.80	55	1.40	148	2.00	347	2.60	630
0.90	66	1.50	174	2.10	390	2.70	681
1.00	78	1.60	203	2.20	436	2.80	733
1.10	91	1.70	235	2.30	483	2.90	786

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 1 foot and 2.1 feet.

Estimated monthly discharge of Little Truckee River at Pine Station, Cal., for 1905.

[Drainage area, 166 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	126	77	101	6,210	.608	.701
February	144	57	89.0	4,943	.536	.558
March	277	139	188	11,560	1.13	1.30
April	760	183	334	19,870	2.01	2.24
May	640	307	477	29,330	2.87	3.31
June	483	122	337	20,050	2.03	2.26
July	148	50	86.3	5,306	.520	.600
August	50	33	42.1	2,589	.254	.293
September	48	33	37.4	2,226	.225	.251
October	45	42	44.2	2,718	.266	.307
November	107	40	55.4	3,296	.334	.373
December	126	78	106	6,518	.637	.734
The year	760	33	158	114,600	.952	12.93

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

INDEPENDENCE CREEK BELOW INDEPENDENCE LAKE, CAL.

Independence Creek flows from the east end of Independence Lake northeastward into Little Truckee River.

The gaging station was established October 24, 1902, It is located about one-eighth of a mile below the dam at the lower end of Independence Lake, Cal.

The channel is straight for 50 feet above and below the station. The banks are low and subject to overflow. The bed of the stream is permanent, being composed of gravel and clay, but during high water large quantities of sand are washed down the creek. The current is moderately rapid and the discharge is controlled by the dam at the end of the lake.

Discharge measurements are made from a cable and car.

The gage, which is read twice daily by William Schweinberger, consisted originally of a vertical 4 by 4 inch timber, located about 200 feet upstream from the cable. For the convenience of the observer a new vertical gage, made of 2 by 4 inch timber, was established July 1, 1904, on the left bank of the stream 75 feet below the outlet of the lake. Simultaneous readings taken on the two gages give identical results for the fluctuations of 1904. The bench mark for the original gage consists of three nails driven into the root of a pine tree 55 feet northwest of the gage; elevation above zero of gage, 5.82 feet. The bench mark for

the new gage is the head of four nails driven into the tree stump to which the new gage rod is fastened; elevation above zero of new gage, 3.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 121; 100, p 197; 133, p 315.
Discharge: 85, p 122; 100 p 197; 133, p 315.
Discharge, monthly: 100, p 199; 133, p 317.
Gage heights: 85, p 122; 100, p 198; 133, p 316.
Rating table: 100, p 199; 133, p 317.

Discharge measurements of Independence Creek below Independence Lake, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
June 12	W. A. Wolf	28	62	1.24	3.25	77
June 26	do		3	1.00	1.80	3
July 7	do	11	9	1.67	2.30	15
August 3	do	6	3	1.48	2.00	4.3
September 11	do				1.70	[a] .5

[a] Estimated.

Daily gage height, in feet, of Independence Creek below Independence Lake, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.7	2.5	2.7	3.28	3.2	1.88	2.0	1.65	1.5	1.5	2.18
2	2.1	2.58	2.5	2.7	3.5	3.2	2.0	2.0	1.65	1.5	1.5	2.15
3	2.15	2.4	2.5	2.45	3.5	3.1	2.1	2.0	1.65	1.5	1.45	2.12
4	2.15	2.3	2.5	2.25	3.5	3.1	2.2	2.0	1.65	1.5	1.45	2.1
5	2.15	2.2	2.5	2.25	3.5	3.1	2.25	2.0	1.65	1.5	1.45	2.3
6	2.18	2.2	2.5	2.25	3.35	3.1	2.3	2.0	1.65	1.5	1.45	2.5
7	2.2	2.2	2.5	2.25	3.15	3.05	2.3	1.95	1.65	1.5	1.45	2.25
8	2.2	2.2	2.5	2.28	3.1	3.08	2.3	1.95	1.65	1.5	1.45	2.0
9	2.2	2.2	2.5	2.3	3.05	3.1	2.3	1.95	1.65	1.5	1.45	2.0
10	2.2	2.2	2.5	2.3	3.15	3.15	2.25	1.95	1.65	1.5	1.38	1.98
11	2.22	2.2	2.5	2.3	2.7	3.18	2.25	1.9	1.65	1.5	2.35	1.95
12	2.25	2.2	2.5	2.3	2.7	3.2	2.25	1.9	1.6	1.5	2.3	1.95
13	2.32	2.2	2.5	2.3	2.7	3.2	2.2	1.9	1.6	1.5	2.25	1.92
14	2.52	2.22	2.5	2.3	2.7	3.2	2.18	1.9	1.6	1.5	2.2	1.9
15	2.6	2.25	2.5	2.3	2.7	3.22	2.1	1.9	1.6	1.5	2.2	1.88
16	2.6	2.25	2.5	2.3	2.7	3.22	2.1	1.85	1.6	1.5	2.15	1.88
17	2.6	2.25	2.5	2.3	2.88	3.2	2.1	1.85	1.55	1.5	2.15	1.85
18	2.62	2.25	2.5	2.65	3.08	3.2	2.05	1.85	1.55	1.5	2.1	1.85
19	2.65	2.38	2.5	3.05	3.08	3.2	2.05	1.85	1.55	1.5	2.1	1.9
20	2.68	2.48	2.6	3.05	3.28	3.2	2.05	1.85	1.55	1.5	2.15	1.9
21	2.88	2.5	2.7	3.05	3.45	3.15	2.08	1.85	1.55	1.5	2.1	1.9
22	2.98	2.5	2.7	3.2	3.45	3.15	2.1	1.85	1.55	1.5	2.1	1.85
23	2.98	2.5	2.7	3.1	3.45	3.15	2.15	1.85	1.55	1.5	2.1	1.85
24	3.02	2.5	2.7	3.1	3.0	3.1	2.2	1.8	1.55	1.5	2.5	1.82
25	3.12	2.5	2.8	3.1	2.55	3.08	2.2	1.75	1.55	1.5	2.5	1.84
26	3.25	2.5	2.72	3.1	2.55	2.4	2.15	1.75	1.55	1.5	2.25	1.8
27	3.25	2.5	2.75	3.1	2.55	1.8	2.1	1.7	1.55	1.5	2.12	1.85
28	3.08	2.5	2.75	3.1	3.05	1.8	2.1	1.7	1.5	1.5	2.15	1.85
29	2.85	.....	2.75	3.1	3.08	1.82	2.05	1.68	1.5	1.5	2.2	1.9
30	2.85	.....	2.75	3.1	3.18	1.88	2.05	1.65	1.5	1.5	2.2	1.9
31	2.85	.....	2.75	.....	3.2	.....	2.05	1.65	.....	1.5	.....	1.98

Station rating table for Independence Creek below Independence Lake, Cal., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	0.3	1.90	3.4	2.50	23	3.10	107
1.40	.4	2.00	4.7	2.60	30	3.20	127
1.50	.5	2.10	6.7	2.70	40	3.30	148
1.60	.9	2.20	9.5	2.80	53	3.40	170
1.70	1.5	2.30	13	2.90	69	3.50	192
1.80	2.3	2.40	17	3.00	87		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 2 feet and 3.25 feet. Below 2 feet the table is rather uncertain.

Estimated monthly discharge of Independence Creek below Independence Lake, Cal., for 1905.

[Drainage area, 8.5 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	137	6.7	43.0	2,644	5.06	5.83
February	40	9.5	16.4	911	1.93	2.01
March	53	23	30.7	1,888	3.61	4.16
April	127	11	52.7	3,136	6.20	6.92
May	192	26	107	6,579	12.59	14.52
June	131	2.3	98.9	5,885	11.64	12.98
July	13	3.2	8.2	504	.965	1.11
August	4.7	1.2	3.1	191	.365	.419
September	1.2	.5	.90	54	.106	.118
October	.5	.5	.50	31	.059	.068
November	23	.4	7.0	417	.824	.919
December	23	2.3	5.1	314	.600	.692
The year	192	.4	31.1	22,550	3.66	49.75

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

PROSSER CREEK NEAR HOBART MILLS, CAL.

Prosser Creek rises on the eastern slope of the Sierra Nevada in central Sierra County, Cal., flows in a general southeasterly direction, and unites with Truckee River near Prosser.

The station was established June 27, 1903. It is located about 150 feet below the wagon bridge and the road house on the Boca and Truckee highway, 4 miles from Truckee and 3 miles from Hobart Mills. Alder Creek joins Prosser Creek about 200 feet above the station. The nearest dam is located at the ice pond about 2 miles below the station.

The channel is straight for 150 feet above and 200 feet below the cable. The creek bends at the highway bridge. Both banks are high and are not subject to overflow. The right bank is wooded; the left is cleared except for a few willows. The bed is composed of coarse gravel and is free from vegetation. There is but one channel at all stages.

Discharge measurements are made from a wooden car running on a three-eighths inch steel cable, which is stretched across the river about 5 feet above high-water level. A tag wire is stretched just above the cable.

The original gage consisted of a 2 by 4 inch vertical timber. It was located on the left or north bank 50 feet upstream from the cable. The old gage, the zero of which was 9.87 feet below the bench mark, was washed out by a flood February 24, 1904. A new gage was established at the same point, with its zero 9.58 feet below the bench mark. The bench

mark is on the northeast pier of the steel wagon bridge, and is the top of the steel casing of the concrete pier above the arrow mark.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 200-201; 133, p 318.
Discharge: 100, p 201; 133, p 318.
Discharge, monthly: 133, p 320.
Gage heights: 100, p 201; 133, p 319.
Rating table: 133, p 319.

Discharge measurements of Prosser Creek near Hobart Mills, Cal., in 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Feet per second.*	*Feet.*	*Second-feet.*
May 12	W. A. Wolf	57	2.22	2.05	129
May 23	do	69	2.60	2.30	179
June 12	do	68	2.43	2.25	165
June 26	do	55	2.20	2.00	120
July 7	do	55	1.91	1.90	101
July 27	do			1.25	11

DONNER CREEK NEAR TRUCKEE, CAL.

Donner Creek flows from the east end of Donner Lake eastward into Truckee River.

The gaging station was established October 23, 1902. It is located about 150 feet below the dam of the Donner Creek Ice Company and 1½ miles west of Truckee, Cal.

The channel is straight for 150 feet above and below the cable. Both banks are high and will not overflow. The bed of the stream is composed of gravel, is permanent, and is free from vegetation. There is but one channel at all stages and the current is swift.

Discharge measurements are made by means of a cable and car 50 feet downstream from the gage.

The gage, which is read twice each day by F. R. Williams, is a 4 by 4 inch vertical timber located on the left bank. The bench mark consists of four nails driven into the root of a pine tree 12 inches in diameter 35 feet north of the gage; elevation above zero of gage, 6.30 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 123; 100, p 202; 133, p 320.
Discharge: 51, p 405; 85, p 123; 100, p 202; 133, p 321.
Discharge, monthly: 100, p 204; 133, p 322.
Gage heights: 85, p 123; 100, pp 202-203; 133, p 321.
Rating table: 100, p 203; 133, p 322.

Discharge measurements of Donner Creek near Truckee, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 15	W. A. Wolf	36	48	3.27	3.06	157
May 12	do	36	48	3.25	3.01	156
May 23	do	38	56	4.00	3.42	224
June 26	do	20	17	2.18	2.12	37
July 6	do	10	12	1.34	1.74	16.0
July 27	do				1.15	1.0
August 2	do				.90	.2
September 9	do				1.00	.5

Daily gage height, in feet, of Donner Creek near Truckee, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	1.7	3.0	2.7	3.6	3.3	1.9	1.1	1.0	1.0	0.65	2.2
2	1.9	1.8	3.0	2.6	3.5	3.2	1.9	.95	2.25	1.0	.75	.0
3	1.9	1.8	3.0	2.6	3.45	3.15	1.9	.9	2.2	.95	.8	.0
4	1.7	1.8	3.0	2.65	3.4	3.05	1.85	.9	1.1	.95	.8	.0
5	1.7	1.8	3.05	2.75	3.35	3.0	1.8	1.0	1.2	.95	.8	.0
6	1.7	1.8	3.1	2.8	3.3	3.0	1.75	1.05	1.15	.5	.85	.9
7	1.7	1.8	3.1	2.8	3.3	3.0	1.7	1.0	1.0	.45	.9	.9
8	1.7	1.7	3.0	2.9	3.3	3.0	1.7	1.0	1.0	1.0	.9	.9
9	1.7	1.7	3.0	3.0	3.25	3.0	1.65	1.0	1.0	1.5	.9	.9
10	1.6	1.7	3.0	3.1	3.15	3.0	1.6	1.0	1.0	1.6	.9	.9
11	1.6	1.7	3.0	3.0	3.1	3.0	1.55	1.0	1.0	1.75	.9	.9
12	1.6	1.9	3.0	3.1	3.05	3.0	1.55	1.0	1.0	1.6	.9	.9
13	1.6	2.2	3.0	3.1	3.0	2.95	1.5	1.0	1.0	1.8	.9	.9
14	1.9	2.[illegible]	2.9	3.1	3.1	2.95	1.45	1.0	1.0	1.8	.9	.9
15	1.9	2.2	2.9	3.1	3.25	2.9	1.5	1.0	1.0	1.55	.9	.9
16	1.9	2.2	2.8	3.1	3.5	2.85	1.4	1.0	1.0	1.35	1.2	.9
17	1.9	2.2	2.8	3.1	3.55	2.85	1.35	1.0	1.0	1.15	1.15	.9
18	1.8	2.2	2.8	3.05	3.6	2.85	1.3	1.0	1.0	1.05	.95	.9
19	1.8	2.25	2.8	3.0	3.6	2.8	1.3	1.0	1.0	1.05	.9	.9
20	1.7	2.5	2.8	3.0	3.5	2.8	1.25	1.0	1.0	1.0	.9	.9
21	1.7	2.4	2.8	3.0	3.5	2.7	1.2	1.0	1.0	1.0	.9	.9
22	1.9	2.3	2.8	3.0	3.5	2.55	1.15	1.0	1.0	1.0	.9	.9
23	1.8	2.35	2.8	3.05	3.4	2.35	1.1	1.0	1.0	1.45	.9	.9
24	1.8	2.35	2.8	3.1	3.4	2.25	1.2	1.0	1.0	1.8	.9	.9
25	1.8	3.2	2.8	3.1	3.4	2.2	1.15	1.0	1.0	1.0	.9	.9
26	1.7	3.15	2.8	3.5	3.4	2.15	1.15	1.0	1.0	.0	.9	.95
27	1.7	3.05	2.8	3.7	3.35	2.1	1.15	1.0	1.0	.0	.9	1.0
28	1.8	3.0	2.8	3.6	3.3	2.1	1.15	1.0	1.0	.0	.9	1.0
29	1.8	.....	2.8	3.65	3.3	2.0	1.15	1.0	1.0	.15	.9	1.0
30	1.7	.....	2.7	3.6	3.3	2.0	1.15	1.0	1.0	.45	.9	1.0
31	1.7	.....	2.7	.....	3.3	.....	1.12	1.0	.....	.55	.....	1.0

Station rating table for Donner Creek near Truckee, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge
Feet.	*Second-feet.*	*Feet*	*Second-feet*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.70	0.0	1.50	8.3	2.30	52	3.10	166
.80	.1	1.60	11.5	2.40	62	3.20	185
.90	.2	1.70	15	2.50	73	3.30	206
1.00	.5	1.80	19	2.60	86	3.40	227
1.10	1.1	1.90	24	2.70	100	3.50	248
1.20	2.0	2.00	29	2.80	115	3.60	269
1.30	3.5	2.10	35	2.90	131	3.70	290
1.40	5.7	2.20	43	3.00	148		

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined.

Estimated monthly discharge of Donner Creek near Truckee, Cal., for 1905.

[Drainage area, 30 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	24	11.5	17.8	1,094	0.593	0.684
February	185	15	53.1	2,949	1.77	1.84
March	166	100	130	7,993	4.33	4.99
April	290	86	163	9,699	5.43	6.06
May	269	148	218	13,400	7.27	8.38
June	206	29	114	6,783	3.80	4.24
July	24	1.1	8.6	529	.287	.331
August	1.1	.2	.51	31	.017	.020
September	48	.5	3.6	214	.120	.134
October	19	0	4.4	270	.147	.170
November	2	0	.29	17	.0097	.011
December	43	0	1.6	98	.053	.061
The year	290	0	59.6	43,290	1.98	26.92

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

WALKER RIVER BASIN.

DESCRIPTION OF BASIN.

Walker River is formed by two branches—East and West forks—which rise on the eastern slopes of the Sierra Nevada, in Mono County, Cal., flow in a general northerly direction, and unite in Lyon County, Nev. From the point of junction the main stream flows northward through Mason Valley, at the upper end of which it turns to the east and southeast and discharges into the north end of Walker Lake.

WEST FORK OF WALKER RIVER NEAR COLEVILLE, CAL.

This station was established October 5, 1902. The cable is located about 1 mile east of the point where the main road from Topaz to Bridgeport crosses Lost Canyon Creek and is 600 feet from the road. The gage is about one-half mile above the cable.

The channel is straight for 150 feet above and below the station. The right bank is low and rocky and is liable to overflow; the left is high and rocky and will not overflow. The bed of the stream is rocky and uneven. There is but one channel at all stages and the current is swift.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire.

The gage, which is read once each day by J. S. Trumbull, is a 4 by 4 inch vertical timber on the left bank, about 300 feet from the observer's house. The bench mark is a spike driven into the tree to which the gage is fastened; elevation above zero of gage, 6.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 108; 100, pp 172-173; 133, p 323.
Discharge: 85, p 108; 100, p 173; 133, p 323.
Discharge, monthly: 100, p 174; 133, p 325.
Gage heights: 85, p 108; 100, p 173; 133, p 324.
Rating table: 100, p 174; 133, p 324.

Discharge measurements of West Fork of West Walker River near Coleville, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 3	J. L. Brambila	51	109	3.20	2.50	[illegible]
May 11	do	48	98	2.37	2.15	[illegible]
May 24	do	55	165	5.13	3.45	[illegible]
June 6	do	55	160	4.11	3.10	[illegible]
June 29	do	55	160	4.35	3.20	[illegible]
July 8	do	55	147	4.40	3.10	[illegible]
July 24	do	47	99	2.04	2.00	[illegible]
July 25	do	54	134	2.48	2.30	[illegible]
August 30	W. A. Wolf	50	82	.99	1.30	[illegible]

Daily gage height, in feet, of West Fork of Walker River near Coleville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.4	1.5	1.7	2.9	3.1	2.9	1.9	1.2	1.2	1.1	0.9
2	1.3	1.4	1.5	1.7	2.7	3.1	2.9	1.9	1.1	1.2	1.1	.9
3	1.2	1.4	1.5	1.8	2.7	3.0	2.8	1.8	1.2	1.2	1.1	[illegible]
4	1.2	1.4	1.6	1.8	2.6	3.1	2.7	1.8	1.2	1.2	1.9	[illegible]
5	1.2	1.3	1.7	2.0	2.1	3.1	2.6	1.8	1.2	1.2	1.1	1.1
6	1.2	1.3	1.7	2.1	2.3	3.0	2.7	1.7	1.2	1.05	1.1	1.1
7	1.2	1.4	1.7	2.1	2.3	2.9	2.7	1.6	1.2	1.1	1.1	1.1
8	1.2	1.4	1.7	2.1	2.2	3.0	2.8	1.6	1.2	1.1	1.1	1.1
9	1.2	1.4	1.7	2.2	2.2	3.1	2.8	1.6	1.2	1.05	1.1	1.2
10	1.2	1.3	1.7	2.1	2.1	3.2	2.7	1.6	1.1	1.05	1.1	1.2
11	1.2	1.3	1.7	2.1	2.1	3.5	2.7	1.5	1.1	1.05	1.1	1.1
12	1.2	1.3	1.7	2.1	2.2	3.7	2.6	1.5	1.1	1.05	.9	1.1
13	1.2	1.3	1.7	2.1	2.3	3.9	2.5	1.5	1.1	1.05	.9	1.1
14	1.2	1.3	1.7	2.1	2.9	3.9	2.5	1.5	1.1	1.05	.8	1.1
15	1.2	1.3	1.7	2.0	3.4	3.8	2.4	1.5	1.1	1.05	.8	1.2
16	1.2	1.4	1.7	2.1	3.5	3.6	2.4	1.5	1.1	1.0	.8	1.2
17	1.2	1.4	1.7	2.1	3.5	3.6	2.3	1.4	1.1	1.0	.9	1.1
18	1.2	1.3	1.8	2.2	3.6	3.7	2.2	1.4	1.1	1.0	.9	1.1
19	1.2	1.3	1.8	2.2	3.5	3.8	2.1	1.4	1.1	1.0	.9	1.1
20	1.3	1.3	1.8	2.1	3.5	3.9	2.1	1.4	1.05	1.0	.9	1.1
21	1.3	1.3	1.7	2.0	3.4	3.8	2.2	1.4	1.05	1.0	.9	1.1
22	1.3	1.3	1.7	2.1	3.3	3.7	2.2	1.4	1.05	1.0	.8	1.1
23	1.3	1.3	1.6	2.2	3.2	3.5	2.2	1.4	1.05	1.0	.9	1.1
24	1.4	1.3	1.6	2.2	3.3	3.3	2.2	1.4	1.05	1.0	.9	1.2
25	1.4	1.4	1.6	2.4	3.3	3.1	2.2	1.3	1.05	1.0	.8	1.2
26	1.3	1.4	1.6	2.5	3.2	3.0	2.1	1.3	1.05	1.0	.9	1.2
27	1.3	1.4	1.6	2.4	3.0	2.9	2.1	1.2	1.05	1.0	.9	1.1
28	1.3	1.5	1.6	2.9	2.9	2.8	2.1	1.2	1.2	1.0	.9	1.1
29	1.3	.....	1.6	3.1	2.8	2.8	2.0	1.2	1.2	1.0	1.1	.9
30	1.3	.....	1.8	3.1	3.0	2.9	2.0	1.2	1.2	1.0	1.1	.9
31	1.3	.....	1.7	.....	3.1	.....	2.0	1.2	.....	1.0	.....	.9

Station rating table for West Fork of Walker River near Coleville, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	44	1.60	121	2.40	317	3.20	702
.90	50	1.70	138	2.50	353	3.30	762
1.00	56	1.80	157	2.60	393	3.40	823
1.10	62	1.90	178	2.70	436	3.50	886
1.20	70	2.00	201	2.80	483	3.60	952
1.30	80	2.10	226	2.90	534	3.70	1,020
1.40	92	2.20	254	3.00	588	3.80	1,090
1.50	106	2.30	284	3.10	644	3.90	1,160

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 3.5 feet.

Estimated monthly discharge of West Fork of Walker River near Coleville, Cal., for 1905.

[Drainage area, 306 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	92	70	75.3	4,630	0.246	0.284
February	106	80	86.1	4,782	.281	.293
March	157	106	133	8,178	.435	.502
April	644	138	266	15,830	.869	.970
May	952	226	558	34,310	1.82	2.10
June	1,160	483	791	47,070	2.58	2.88
July	534	201	334	20,540	1.09	1.26
August	178	70	107	6,579	.350	.404
September	70	59	64.1	3,814	.209	.233
October	70	56	59.4	3,652	.194	.224
November	178	44	58.1	3,457	.190	.212
December	70	50	61.9	3,806	.202	.233
The year	1,160	44	216	156,600	.706	9.60

NOTE.—Ice conditions not known. Open-channel rating table applied to winter months without correction.

EAST FORK OF WALKER RIVER NEAR YERINGTON, NEV.

This station was established October 6, 1902. It is located at Ross Ranch, about 10 miles southeast of Yerington, Nev., just above the point where the road crosses the river.

The channel is straight for 200 feet above and for 100 feet below the station. At low water the sand bar in the middle of the stream divides the channel into two parts. Both banks are low and are liable to overflow. The bed of the stream is composed of sand and clay and shifts somewhat. The current has a moderate velocity.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire.

The gage, which is read once each day by I. A. Strosnider, the ranch owner, is a vertical 4 by 4 inch timber fastened to the right bank just below the cable. The bench mark consists of three nails and a spike in a stump 6 inches in diameter 15 feet east of the gage; elevation above zero of gage, 5.85 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 107; 100, p 170; 133, p 325.
Discharge: 85, p 108; 100, p 170; 133, p 326.

Discharge, monthly: 100, p 172; 133, p 327.
Gage heights: 85, p 108; 100, pp 170-171; 133, p 326.
Rating table: 100, p 171; 133, p 327.

Discharge measurements of East Fork of Walker River near Yerington, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 4	J. L. Brambila	50	36	1.86	1.80	67
May 9	do	73	36	1.92	1.79	69
May 18	do	73	54	2.10	2.50	113
May 23	do	54	37	2.20	1.92	81
June 5	do	49	28	2.14	1.90	60
June 15	do	72	70	2.43	2.40	170
June 19	do	73	99	2.94	2.75	291
June 30	do	71	69	2.27	2.35	156
July 7	do	72	64	2.19	2.30	141
July 26	do	71	48	1.73	2.08	82
July 28	do	72	51	1.66	2.05	84

Daily gage height, in feet, of East Fork of Walker River near Yerington, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.2	2.4	2.2	1.5	2.1	2.3	1.9	1.6	1.7	1.9	2.0
2	2.1	2.2	2.4	2.2	1.5	2.1	2.35	1.9	1.6	1.7	1.9	2.0
3	2.1	2.2	2.4	2.2	1.5	2.05	2.4	1.9	1.6	1.7	1.9	2.0
4	2.1	2.2	2.4	2.2	1.6	2.05	2.4	1.8	1.7	1.7	1.9	1.9
5	2.1	2.3	2.35	2.2	1.45	2.0	2.4	1.8	1.7	1.7	1.9	1.9
6	2.1	2.3	2.3	2.2	1.4	1.9	2.3	1.8	1.7	1.7	1.9	1.9
7	2.1	2.3	2.3	2.2	1.4	1.9	2.3	1.8	1.7	1.7	1.9	1.9
8	2.1	2.3	2.3	2.2	1.4	1.9	2.25	1.8	1.7	1.7	1.9	1.9
9	2.1	2.3	2.3	2.2	1.4	1.9	2.2	1.8	1.7	1.7	1.9	1.9
10	2.1	2.3	2.3	2.2	1.4	1.9	2.2	1.7	1.6	1.6	1.9	1.9
11	2.1	2.3	2.3	2.2	1.4	2.0	2.2	1.7	1.6	1.6	1.9	1.9
12	2.1	2.3	2.3	2.1	1.4	2.1	2.3	1.7	1.6	1.6	1.9	1.9
13	2.15	2.3	2.3	2.1	1.45	2.2	2.3	1.7	1.6	1.6	1.9	1.9
14	2.2	2.3	2.3	2.1	1.45	2.3	2.2	1.7	1.6	1.6	1.9	1.9
15	2.2	2.3	2.3	2.1	1.65	2.4	2.1	1.7	1.6	1.6	1.9	1.9
16	2.2	2.3	2.2	2.1	1.75	2.5	2.0	1.7	1.6	1.7	1.9	1.9
17	2.2	2.3	2.2	2.1	2.0	2.65	2.0	1.6	1.7	1.7	1.9	1.9
18	2.2	2.3	2.2	2.0	2.2	2.7	2.0	1.6	1.7	1.7	1.9	1.9
19	2.2	2.4	2.2	2.0	2.2	2.7	2.0	1.6	1.7	1.7	1.9	1.9
20	2.2	2.4	2.2	2.0	2.2	2.75	1.95	1.6	1.7	1.7	2.0	1.9
21	2.2	2.4	2.2	1.9	2.1	2.75	1.9	1.6	1.7	1.7	2.0	1.9
22	2.2	2.4	2.2	1.9	2.1	2.75	1.95	1.75	1.7	1.7	2.0	1.9
23	2.2	2.4	2.2	1.9	2.1	2.85	2.1	1.8	1.7	1.8	2.0	1.9
24	2.2	2.4	2.2	1.8	2.0	2.85	2.1	1.8	1.7	1.8	2.0	1.9
25	2.2	2.4	2.2	1.8	2.0	2.75	2.1	1.8	1.7	1.8	2.0	1.9
26	2.2	2.4	2.2	1.7	2.0	2.55	2.1	1.7	1.7	1.8	2.0	1.9
27	2.2	2.4	2.2	1.7	2.0	2.4	2.1	1.7	1.7	1.9	2.0	1.9
28	2.2	2.4	2.2	1.75	2.2	2.3	2.05	1.7	1.7	1.9	2.0	1.9
29	2.2	.....	2.2	1.6	2.2	2.35	2.0	1.7	1.8	1.9	2.0	1.9
30	2.2	.....	2.2	1.6	2.1	2.4	2.0	1.6	1.8	1.9	2.0	1.9
31	2.2	.....	2.2	.....	2.1	.....	1.9	1.6	.....	1.9	.....	1.9

Daily discharge, in second-feet, of East Fork of Walker River near Yerington, Nev., for 1905.

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1	37	91	146	12	15	109	134	22	94	280	69
2	37	91	156	13	18	125	134	23	110	304	90
3	37	84	166	14	18	150	116	24	95	304	90
4	37	79	162	15	25	170	100	25	95	275	83
5	32	72	162	16	34	191	80	26	87	210	83
6	27	60	143	17	46	237	80	27	87	176	83
7	27	60	143	18	69	262	80	28	118	156	84
8	25	66	130	19	69	291	80	29	115	156	78
9	25	66	123	20	81	306	73	30	98	156	78
10	25	72	123	21	82	306	63	31	98	.....	65
11	25	86	115								

NOTE.—Discharge applied by indirect method for shifting channels. As no measurements were made January-April and August-December no estimates for these months can be made.

Estimated monthly discharge of East Fork of Walker River near Yerington, Nev., for 1905.

[Drainage area, 1,103 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May	118	15	57.7	3,548	0.052	0.060
June	306	60	167	9,937	.151	.168
July	166	63	107	6,579	.097	.112

WALKER RIVER NEAR WABUSKA, NEV.

This station was established July 22, 1902, and equipped December 12, 1902. It is located about 300 feet above the Carson and Colorado Railroad bridge, near the section house at Clever station, and about 2½ miles east of Wabuska.

The channel is straight for 150 feet above the station and slightly curved for the same distance below. Both banks are high and are not liable to overflow. The bed of the stream is sandy and shifting. There is but one channel at all stages. The current has a moderate velocity, and the discharge is small from August to October.

Discharge measurements are made by means of a cable and car 35 feet below the gage. The initial point for soundings is the zero of the tagged wire.

The gage is read twice each day by Charles Nelson. The original gage was washed out December 30, 1903. A new gage, consisting of a 1 by 4 inch board fastened to a vertical 4 by 4 inch timber, was installed January 17, 1904. It is on the left bank, 15 feet below the point at which the old gage was located and 150 feet south of the section house. The datum is the same as that of the original gage. The bench mark consists of four nails driven into the northwest corner of the pump platform 35 feet east of the gage; elevation above zero of gage, 6.94 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 106; 100, p 167; 133, p 328.
Discharge: 85, p 107; 100, p 168; 133, p 328.
Discharge, monthly: 100, p 169; 133, p 330.
Gage heights: 85, p 107; 100, p 168; 133, p 329.
Rating table: 100, p 169; 133, p 329-330.

Discharge measurements of Walker River near Wabuska, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 5	J. L. Brambila	74	64	1.46	1.58	94
May 8	do	73	50	1.42	1.39	71
May 19	do	78	136	2.43	2.30	330
May 22	do	72	118	2.55	2.30	304
June 4	do	70	69	1.79	1.60	124
June 18	do	74	186	2.08	2.80	536
July 1	do	70	64	1.78	1.40	114
July 6	do	67	37	1.54	1.10	57
July 27	do	15	.....	.....	.60	[a] 34

[a] Estimated.

Daily gage height, in feet, of Walker River, near Wabuska, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	1.92	1.98	1.95	1.28	1.72	1.4	0.6	0.45	0.5	0.45	0.75
2	2.05	2.0	2.0	2.0	1.58	1.7	1.4	.55	.45	.5	.45	.75
3	2.05	2.05	2.0	2.0	1.75	1.7	1.33	.55	.45	.5	.45	.7
4	2.0	2.1	2.0	1.98	1.7	1.62	1.28	.55	.45	.5	.45	.75
5	2.0	2.1	2.0	1.94	1.63	1.6	1.2	.55	.45	.5	.45	.8
6	2.0	2.05	2.02	1.92	1.58	1.65	1.2	.55	.45	.5	.45	.95
7	2.0	2.05	2.05	1.82	1.48	1.72	1.13	.55	.45	.5	.45	.95
8	2.0	2.02	2.05	1.8	1.4	1.82	1.1	.5	.45	.5	.45	1.0
9	2.0	2.0	2.05	1.8	1.4	1.92	1.1	.5	.45	.5	.45	1.0
10	2.0	1.95	2.05	1.8	1.35	1.95	1.1	.5	.45	.5	.45	1.0
11	2.0	1.92	2.05	1.8	1.35	1.98	1.08	.5	.45	.45	.45	1.0
12	2.0	1.9	2.05	1.8	1.28	2.13	1.02	.5	.45	.45	.45	1.0
13	2.0	1.87	2.08	1.7	1.25	2.33	1.0	.5	.45	.45	.45	1.0
14	1.95	1.85	2.1	1.6	1.25	2.65	1.0	.5	.45	.45	.45	.95
15	1.95	1.82	2.1	1.52	1.3	2.88	.95	.5	.45	.45	.45	.95
16	1.9	1.78	2.1	1.48	1.3	2.83	.9	.5	.45	.45	.45	.95
17	1.85	1.75	2.1	1.42	1.3	2.78	.85	.5	.45	.45	.45	.95
18	1.85	1.72	2.15	1.4	1.58	2.78	.85	.5	.45	.45	.45	.95
19	1.8	1.8	2.15	1.38	2.38	2.78	.8	.5	.45	.45	.45	.95
20	1.8	1.85	2.15	1.35	2.4	2.7	.8	.45	.45	.45	.45	.95
21	1.85	1.85	2.15	1.35	2.3	2.63	.8	.45	.45	.45	.5	.95
22	1.9	1.88	2.15	1.32	2.3	2.6	.8	.45	.45	.45	.55	.95
23	1.9	1.9	2.15	1.3	2.15	2.6	.75	.48	.45	.45	.7	.95
24	1.9	1.9	2.1	1.28	1.9	2.55	.68	.5	.45	.45	.65	.95
25	1.9	1.9	2.1	1.22	1.85	2.43	.68	.5	.45	.45	.65	.95
26	1.9	1.9	2.08	1.2	1.9	2.15	.6	.5	.45	.45	.7	.95
27	1.9	1.9	2.02	1.2	2.05	1.7	.6	.5	.45	.45	.7	1.0
28	1.9	1.95	2.0	1.2	2.05	1.45	.6	.5	.45	.45	.7	1.0
29	1.9	.....	2.0	1.15	2.0	1.38	.6	.45	.45	.45	.7	1.0
30	1.9	.....	2.0	1.15	1.9	1.33	.6	.45	.5	.45	.75	1.0
31	1.9	.....	2.0	.....	1.82	.....	.6	.45	.....	.45	.....	1.0

NOTE.—Ice conditions not known.

Station rating table for Walker River near Wabuska, Nev., from May 1 to June 15, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.20	40	1.70	135	2.20	280	2.60	440
1.30	56	1.80	159	2.30	316	2.70	488
1.40	73	1.90	185	2.40	354	2.80	538
1.50	92	2.00	214	2.50	395	2.90	588
1.60	113	2.10	246				

The above table is based on six discharge measurements made during 1905. Estimates only approximate owing to shifting character of stream bed.

Station rating table for Walker River near Wabuska, Nev., from June 16 to July 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.60	30	1.20	84	1.80	186	2.40	366
0.70	36	1.30	97	1.90	210	2.50	405
0.80	44	1.40	111	2.00	236	2.60	447
0.90	53	1.50	127	2.10	264	2.70	491
1.00	62	1.60	144	2.20	295	2.80	538
1.10	72	1.70	164	2.30	329		

The above table is based on four discharge measurements made during 1905. Estimates only approximate owing to shifting character of stream bed.

Estimated monthly discharge of Walker River near Wabuska, Nev., for 1905.

[Drainage area, 2,420 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
May	354	48	149	9,162	0.062	0.071
June	578	101	295	17,550	.122	.136
July	111	30	58.3	3,585	.024	.028

CARSON RIVER BASIN.

DESCRIPTION OF BASIN.

Carson River has its sources on the eastern slopes of the Sierra Nevada in Alpine County, Cal. Flowing northward into Nevada, East and West forks unite near Genoa, in the upper Carson Valley. At Empire, 3 miles east of the city of Carson, the river turns to the northeast and enters a deep canyon, through which it flows for several miles, emerging into a second, smaller valley a short distance above the town of Dayton. After leaving this valley it passes through two shorter canyons and one rather large valley before entering lower Carson Valley, or Carson Sink Valley, as it is also known, and discharging its waters into Carson Sink.

WEST FORK OF CARSON RIVER NEAR WOODFORDS, CAL.

West Fork of Carson River rises in Alpine County, Cal., flows in a general northerly direction, and unites with East Fork in Douglas County, Nev.

The gaging station was established October 18, 1900. It is located about three-fourths of a mile above the post-office at Woodfords, Cal., and 200 feet from the main road between Woodfords and Blue Lakes.

The channel is straight for 100 feet above and below the cable. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rocky and uneven and is permanent. There is but one channel at all stages. At high water the velocity of the current is too great for accurate measurement.

Discharge measurements are made by means of a cable and car just below the gage. The initial point for soundings is the zero of the tagged wire.

The gage, which is read once each day by Miss Bernice Merrill, is a vertical board nailed to a cottonwood tree on the left bank.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; WS=Water-Supply Paper):

Description: WS 51, p 400; 66, p 109; 85, pp 113-114; 100, p.180; 133, p 331.
Discharge: WS 66, p 109; 85, p 114; 100, p 181; 133, p 331.
Discharge, monthly: Ann 11, ii, p 102; 12, ii, pp 351, 360; 13, iii, p 96, 14, ii, p 118; WS 75, p 188; 85, p 115; 100, p 182; 133, p 333.
Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 59.
Gage heights: WS 51, p 401; 66, p 110; 85, p 114; 100, p 181; 133, p 332.
Rating tables: WS 66, p 175; 85, p 115; 100, p 182; 133, p 332.

Discharge measurements of West Fork of Carson River near Woodfords, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 1	W. A. Wolf	28	53	1.66	2.85	88
April 20	do	31	72	2.59	3.55	186
May 2	J. L. Brambila	30	89	3.69	3.95	328
May 12	do	29	80	2.61	3.50	210
May 16	do	35	113	3.50	4.40	398
May 25	do	30	95	3.19	4.15	305
May 30	do	30	95	3.11	4.00	298
June 7	do	30	80	2.77	3.75	223
June 12	do	30	95	3.04	4.10	288
June 22	do	30	76	2.48	3.60	188
June 28	do	30	57	2.09	3.20	119
July 10	do	30	52	2.00	2.90	104
July 22	do	29	46	1.57	2.50	72
July 30	do	28	34	1.30	2.35	44
August 29	W. A. Wolf	28	26	.96	2.10	25

Daily gage height, in feet, of West Fork of Carson River near Woodfords, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.97	3.05	2.93	4.16	3.85	3.1	2.3	2.0	2.2	2.2	2.3
2	.....	3.01	3.18	2.93	4.2	3.8	3.05	2.35	2.0	2.15	2.2	2.3
3	.....	3.01	3.05	2.97	3.9	3.75	3.05	2.2	2.0	2.1	2.2	2.3
4	.....	2.97	3.05	2.89	3.85	3.55	2.97	2.3	2.0	2.1	2.2	2.3
5	.....	2.93	3.05	2.89	3.7	3.5	2.8	2.25	2.05	2.1	2.2	2.4
6	.....	3.01	2.97	2.97	3.7	3.55	2.89	2.25	2.0	2.15	2.2	2.4
7	.....	3.05	3.01	3.05	3.65	3.7	2.89	2.25	2.0	2.15	2.2	2.5
8	2.77	3.05	3.05	3.14	3.6	3.65	2.75	2.15	2.0	2.2	2.2	2.4
9	2.81	3.05	3.23	3.23	3.6	3.6	2.89	2.15	2.0	2.2	2.2	2.5
10	2.81	3.14	3.23	3.41	3.65	3.7	3.14	2.25	2.0	2.2	2.2	2.5
11	2.85	3.05	3.14	3.41	3.6	3.75	3.05	2.2	2.0	2.2	2.2	2.5
12	2.89	3.05	3.05	3.36	3.65	3.8	3.05	2.2	2.0	2.[illegible]	2.2	2.5
13	2.85	2.97	3.05	3.36	3.8	3.75	2.85	2.15	2.0	2.2	2.2	2.6
14	2.85	3.01	3.14	3.36	3.9	3.75	2.75	2.1	2.0	2.2	2.2	2.55
15	2.89	2.89	3.23	3.81	4.12	3.75	2.65	2.1	2.0	2.15	2.2	2.6
16	2.81	2.89	3.18	3.85	4.08	3.6	2.65	2.1	2.0	2.15	2.2	2.55
17	2.81	2.85	3.5	3.75	4.24	3.65	2.55	2.0	2.0	2.1	2.2	2.6
18	2.85	2.83	3.41	3.7	4.4	3.65	2.6	2.1	2.05	2.15	2.2	2.6
19	2.85	2.81	3.28	3.6	4.36	3.6	2.55	2.1	2.05	2.15	2.2	2.6
20	2.85	2.81	3.23	3.5	4.36	3.5	2.5	2.1	2.1	2.15	2.2	2.55
21	2.81	2.85	3.14	3.85	4.36	3.5	2.5	2.1	2.1	2.2	2.2	2.55
22	2.89	2.89	3.14	3.85	4.36	3.41	2.45	2.15	2.1	2.2	2.2	2.55
23	2.93	2.89	3.23	3.95	4.12	3.36	2.45	2.1	2.1	2.2	2.2	2.65
24	3.05	2.85	3.14	4.12	4.16	3.32	2.5	2.1	2.1	2.2	2.2	2.65
25	2.97	2.89	3.14	4.16	4.16	3.32	2.45	2.1	2.1	2.2	2.2	2.55
26	2.93	2.97	3.23	4.16	4.16	3.28	2.4	2.05	2.2	2.2	2.2	2.55
27	2.85	2.97	3.28	4.24	4.0	3.23	2.45	2.0	2.2	2.2	2.2	2.55
28	2.81	3.05	3.14	4.32	3.9	3.23	2.4	2.0	2.2	2.2	2.4	2.5
29	2.81	.....	3.05	4.32	3.8	3.14	2.5	2.0	2.2	2.2	2.45	2.5
30	2.85	.....	2.89	4.28	3.85	3.18	2.35	2.0	2.2	2.2	2.3	2.5
31	2.89	.....	2.89	.....	3.9	.....	2.3	2.0	.....	2.2	.....	2.5

Station rating table for West Fork of Carson River near Woodfords, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	20	2.70	74	3.30	146	3.90	251
2.10	26	2.80	84	3.40	161	4.00	272
2.20	33	2.90	95	3.50	177	4.10	294
2.30	40	3.00	107	3.60	194	4.20	318
2.40	48	3.10	119	3.70	212	4.30	343
2.50	56	3.20	132	3.80	231	4.40	370
2.60	65						

NOTE.—The above table is applicable only for open channel conditions. It is based on 15 discharge measurements made during 1905. It is fairly well defined.

Estimated monthly discharge of West Fork of Carson River near Woodfords, Cal., for 1905.

[Drainage area, 70 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January 8-31	113	81	91.0	4,332	1.30	1.16
February	124	85	102	5,665	1.46	1.52
March	177	94	125	7,686	1.79	2.06
April	348	94	202	12,020	2.89	3.22
May	370	194	271	16,660	3.87	4.46
June	241	124	187	11,130	2.67	2.98
July	124	40	75.8	4,661	1.08	1.24
August	44	20	28.7	1,765	.410	.473
September	33	20	23.7	1,410	.339	.378
October	33	26	31.3	1,925	.447	.515
November	52	33	34.4	2,047	.491	.548
December	70	40	56.5	3,474	.807	.930
The period				72,780		

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

EAST FORK OF CARSON RIVER NEAR GARDNERVILLE, NEV.

East Fork of Carson River rises in southeastern Alpine County, flows in a general northerly direction, and joins West Fork in Douglas County, Nev.

The gaging station was established October 17, 1900. It is located about 5 miles southeast of Gardnerville, and one-half mile southwest of Rodenbah's ranch. It is within one-half mile of the main traveled road between Carson, Nev., and Bridgeport, Cal., and is about 400 feet above a bridge across the river.

The station is located at the place where measurements were made in 1890, 1891, and 1892.

The channel is straight for 300 feet above and below the station and is broad and shallow. Both banks are high and are not liable to overflow. The bed of the stream is composed of gravel and is permanent. There is but one channel at all stages and the current is moderate.

August 2, 1901, a loose-rock dam was raised a short distance below the gaging station, which affected the velocity at the latter point. This dam was washed out by a freshet December 4, 1901. On or about July 15, 1905, the dam was raised and tightened to such an extent that the water backed up to a point well above the old gage, and for this reason the readings from July 15 to October 8, 1905, are not indicative of the quantity of water flowing in the stream.

Discharge measurements are made by means of a cable and car located at the vertical gage about 400 feet above the bridge. The initial point for soundings is the zero of the tagged wire on the right bank.

The gage is read twice each day by Miss Susie Rodenbah. The original gage was an inclined timber securely fastened to posts set in the right bank of the stream. The bench mark was on a basalt rock in the edge of the stream, 20 feet from the gage and at an elevation of 6.30 feet above gage datum. A new gage was established March 10, 1901, a short distance downstream from the original gage, which had been destroyed. It consists of a vertical timber driven into the stream bed at the right bank and spiked to a cottonwood tree. October 3, 1902, a new inclined gage was installed at a point on the left bank of the

river 600 feet above the cable. During 1904 and up to and including October 8, 1905, gage heights were read on the vertical gage at the cable. On the latter date a new vertical gage was installed at a point about 300 yards above the old gage and firmly fastened to the rocks. The new gage was read from October 8 to the end of the year. The bench mark for the gage at the cable is the top of a granite bowlder 20 feet south of the gage; elevation above zero of gage, 8.10 feet. The bench mark for the new gage is a cross cut in a bowlder 8 feet northeast of the gage; elevation, 6.36 feet above zero of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Discription: Ann 14, ii, p 116; WS 51, pp 399-400; 66, p 108; 85, pp 111-112; 100, pp. 177-178; 133, p 333-334.

Discharge: WS 66, p 108; 85, p 112; 100, p 178; 133, p 334.

Discharge, monthly: Ann 11, ii, p 102; 12, ii, pp 351, 360; 13, iii, p 95; 14, ii, pp. 116-117; WS 75, p. 187; 85, p 113; 100, p 180; 133, p 336.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 59.

Gage heights: WS 51, p 400; 66, p 109; 85, p 112; 100, pp 178-179; 133, p 335.

Hydrograph: Ann 14, ii, p 116.

Rating tables: WS 66, p 175; 85, p 113; 100, p 179; 133, p 336.

Discharge measurements of East Fork of Carson River near Gardnerville, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 2	W. A. Wolf	88	179	1.15	3.80	206
April 21	do	89	201	1.93	4.15	389
May 2	J. L. Brambila	93	256	3.00	4.65	767
May 11	do	88	206	2.15	4.15	444
May 16	do	94	277	3.48	5.00	968
May 25	do	88	291	4.10	5.22	1,205
May 30	do	88	258	3.40	4.85	877
June 7	do	89	264	3.48	4.90	929
June 13	do	90	297	4.00	5.22	1,186
June 21	do	89	270	3.25	4.85	879
June 28	do	85	207	2.33	4.25	482
July 9	do	87	187	1.62	4.00	304
July 24	do	86	168	.96	3.90	161
July 30	do	86	171	.61	3.90	105
August 7	W. A. Wolf	87	147	.70	3.65	90
August 9	do	87	176	.62	3.93	111
August 31	do	72	115	.51	3.20	60
November 2	John Smith	80	127	.56	2.10	71
November 4	do	80	120	.57	2.10	68

Daily gage height, in feet, of East Fork of Carson River near Gardnerville, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	3.58	5.19	3.85	4.5	4.71	4.37	3.79	3.4	3.33	3.3	3.1
2	2.32	3.58	5.19	4.3	5.1	4.68	4.25	3.8	3.39	3.33	3.25	3.1
3	2.34	3.58	5.2	4.25	5.5	4.3	4.2	3.8	3.39	3.32	3.2	3.1
4	2.25	3.6	5.2	4.1	5.2	4.35	4.2	3.82	3.38	3.33	3.2	3.05
5	2.24	3.58	4.88	4.15	4.95	4.45	4.19	3.78	3.37	3.4	3.3	3.04
6	2.24	3.54	4.8	4.2	4.6	4.56	4.15	3.78	3.37	3.4	3.25	3.04
7	2.24	3.54	4.78	4.12	4.15	4.66	4.12	3.72	3.37	3.4	3.2	3.04
8	2.65	3.55	4.68	4.12	4.0	4.69	4.12	3.66	3.36	3.3	3.2	3.04
9	2.8	3.56	4.62	4.1	3.9	4.75	4.11	3.66	3.36	3.3	3.2	3.03
10	2.88	3.58	4.6	3.9	3.8	4.75	4.1	3.95	3.33	3.3	3.2	3.04
11	2.98	3.58	4.6	3.85	4.08	4.8	4.05	4.23	3.32	3.32	3.2	3.05
12	3.2	4.0	4.45	3.85	3.95	4.9	4.0	.....	3.22	3.3	3.2	3.05
13	3.38	4.0	4.5	3.9	4.11	4.95	3.88	4.18	3.21	3.3	3.15	3.05
14	3.6	4.12	4.28	3.9	4.65	4.88	3.83	3.65	3.2	3.3	3.15	3.05
15	3.65	4.12	4.21	3.92	5.4	4.88	3.78	3.78	3.19	3.3	3.15	3.07
16	3.6	4.13	4.19	3.91	6.0	4.85	3.74	3.78	3.19	3.32	3.15	3.09
17	3.6	4.14	4.18	3.9	5.75	4.85	3.9	3.78	3.19	3.3	3.15	3.1
18	3.62	4.14	4.14	3.89	5.65	4.9	3.85	3.78	3.19	3.3	3.15	3.1
19	3.6	4.14	4.05	3.89	5.4	4.93	3.74	3.68	3.19	3.3	3.1	3.1
20	3.62	4.59	4.0	3.9	5.49	4.92	3.7	3.64	3.19	3.3	3.1	3.12
21	3.63	5.0	3.9	3.92	5.42	4.83	3.71	3.62	3.18	3.3	3.1	3.12
22	3.64	5.1	3.95	3.95	5.25	4.8	3.7	3.59	3.18	3.3	3.1	3.12
23	3.66	5.14	3.95	3.98	5.15	4.68	3.72	3.59	3.17	3.2	3.1	3.13
24	3.65	5.16	3.92	4.0	5.18	4.6	3.72	3.52	3.16	3.2	3.1	3.13
25	3.64	5.19	3.95	4.18	5.13	4.53	3.76	3.5	3.15	3.2	3.1	3.13
26	3.6	5.12	3.95	4.2	4.97	4.53	3.79	3.5	3.16	3.2	3.1	3.14
27	3.6	5.12	3.85	4.21	4.85	4.49	3.84	3.5	3.2	3.2	3.1	3.15
28	3.6	5.12	3.8	4.22	4.83	4.41	3.85	3.47	3.3	3.3	3.1	3.15
29	3.6	.....	3.8	4.28	4.85	4.39	3.85	3.41	3.4	3.3	3.1	3.16
30	3.6	.....	3.8	4.3	4.85	4.38	3.86	3.4	3.33	3.3	3.1	3.16
31	3.6	.....	3.85	.....	4.83	.....	3.86	3.4	.....	3.3	.....	3.15

NOTE.—October 8 to December 31, readings made on new gage and reduced to same datum as gage used during the first part of the year.

Station rating table for East Fork of Carson River near Gardnerville, Nev., from January 1 to July 15, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	8	2.80	43	3.60	158	4.40	527
2.10	9	2.90	51	3.70	186	4.50	600
2.20	11	3.00	60	3.80	218	4.60	675
2.30	14	3.10	71	3.90	254	4.70	753
2.40	18	3.20	83	4.00	295	4.80	833
2.50	23	3.30	97	4.10	342	4.90	915
2.60	29	3.40	114	4.20	397	5.00	1,000
2.70	36	3.50	134	4.30	459		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during first half of 1904 and 1905, and several low-water measurements of 1905. It is well defined between gage heights 3 feet and 5 feet. Above 5 feet the curve depends on one measurement at gage height 6.15 feet.

Estimated monthly discharge of East Fork of Carson River near Gardnerville, Nev., for 1905.

[Drainage area, 381 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	175	12	110	6,763	0.289	0.333
February	1,166	144	496	27,550	1.30	1.35
March	1,175	218	533	32,770	1.40	1.61
April	459	236	322	19,160	.845	.943
May	1,930	218	949	58,350	2.49	2.87
June	958	459	742	44,150	1.95	2.18
July 1-15	507	212	346	10,290	.908	.506
The period				199,000		

NOTE.—Ice conditions not known. Open-channel rating table applied to winter months without correction.

CARSON RIVER NEAR EMPIRE, NEV.

This station was established October 21, 1900. It is located about three-fourths of a mile east of Brunswick Mill and 2½ miles east of Empire, Nev.

The channel is straight for 100 feet above and below the station. Both banks are high, rocky, and will not overflow. The bed of the stream is composed of solid rock, gravel, and cobblestones, and is not likely to shift. At flood stages the stream is too deep and swift for satisfactory measurement; at low water the current is sluggish.

Discharge measurements are made by means of a cable and car just below the gage. The initial point for soundings is the zero of the tagged wire on the left bank. Low-water measurements are made by wading one-fourth mile below the cable.

The gage is read once each day by David Lloyd. The original gage was located upstream from the site of the present station. February 18, 1901, the erosion of a bar in the channel above the gage caused the division of the stream into two channels, and on this account the present gage was installed March 13, 1901. The gage consists of an inclined 4 by 4 inch timber spiked to a cottonwood tree on the left bank. November 11, 1903, the gage datum was lowered 1.3 feet to enable readings to be made at extreme low water. The gage is referred to bench marks as follows: (1) Top of a bowlder on the left bank 2 feet west of the gage. Its elevation is 7.10 feet above the zero of the gage as originally established and 8.40 feet above the gage in its present position. (2) Top of bowlder on the left bank 10 feet north of the gage. Elevation is 8.38 feet above the zero of the gage as originally established and 9.68 feet above the zero of the gage in its present position.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull.=Bulletin; WS=Water-Supply Paper):

Description: Ann 12, ii, p 325; Bull 140, p 212; WS 51, p 401; 66, p 110; 85, p 109; 100, p 175; 133, p 337.
Discharge: Bull 140, p 213; WS 66, p 111; 85, p 109; 100, p 175; 133, p 337.
Discharge, monthly. WS 75, p 189; 85, p 111; 100, p 177; 133, p 339.
Gage heights: Bull 140, p 213; WS 51, p 401; 66, p 111; 85, p 110; 100, p 176; 133, p 338.
Hydrographs: Ann 12, ii, p 324; WS 75, p 189.
Rating tables: WS 66, p 175; 85, p 110; 100, p 176; 133, p 338.

Discharge measurements of Carson River near Empire, Nev., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 3	W. A. Wolf	79	187	1.92	3.25	358
May 7	J. L. Brambila	85	266	2.75	4.05	731
May 13	do	85	233	2.08	3.50	484
May 20	do	86	327	3.88	4.80	1,270
May 27	do	85	321	3.54	4.60	1,136
June 3	do	85	275	3.01	4.15	830
June 9	do	83	256	2.51	3.90	642
June 17	do	86	288	3.11	4.30	901
June 24	do	80	231	2.33	3.70	539
July 2	do	80	182	1.85	3.18	338
July 11	do	67	124	.90	2.22	111
July 21	do	57	95	.55	1.95	53

Daily gage height, in feet, of Carson River near Empire, Nev., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.35	2.9	3.1	3.3	4.9	4.4	3.1	1.4	1.1	1.4	2.1	2.2
2	3.3	3.2	3.1	3.3	4.5	4.4	3.2	1.4	.8	1.5	2.1	2.2
3	2.9	3.2	3.1	3.4	4.4	4.3	3.0	1.3	1.1	1.6	2.0	2.3
4	2.9	3.2	3.1	3.4	4.4	4.1	2.9	1.2	.7	1.6	2.0	2.3
5	3.0	3.2	3.2	3.4	4.3	4.0	2.7	1.3	.7	1.6	2.0	2.4
6	3.0	3.2	3.2	3.5	4.2	3.9	2.5	1.2	1.2	1.7	2.0	2.4
7	3.0	3.2	3.2	3.6	4.1	3.9	2.4	1.2	.8	1.8	2.0	2.4
8	2.9	3.2	3.2	3.6	4.0	3.9	2.5	1.2	.9	1.7	2.0	2.4
9	2.9	3.0	3.2	3.7	3.9	4.0	2.4	1.2	1.3	1.7	2.0	2.4
10	2.9	3.0	3.2	3.7	3.8	4.0	2.2	1.3	1.3	1.7	2.0	2.4
11	2.9	3.0	3.2	3.9	3.8	4.1	2.2	1.2	1.2	1.8	2.1	2.4
12	2.8	2.9	3.2	3.8	3.5	4.3	2.2	1.0	.8	1.8	2.1	2.4
13	2.8	3.1	3.2	3.6	3.5	4.5	2.1	1.0	1.2	1.8	2.1	2.4
14	2.8	3.1	3.3	3.5	3.5	4.6	2.1	1.1	.7	1.8	2.1	2.4
15	3.0	2.9	3.4	3.4	3.7	4.4	2.0	1.2	1.3	1.8	2.1	2.3
16	3.0	2.9	3.4	3.6	3.9	4.4	2.0	1.3	.9	1.9	2.1	2.4
17	3.0	3.0	3.3	3.6	4.5	4.3	2.0	1.2	1.3	1.9	2.1	2.5
18	2.9	3.0	3.3	3.5	4.9	4.3	1.9	1.3	1.3	1.9	2.1	2.4
19	2.9	3.0	3.3	3.5	5.0	4.2	1.9	1.3	.9	1.9	2.1	2.3
20	2.9	3.0	3.3	3.5	4.8	4.1	1.9	1.3	1.3	2.0	2.1	2.4
21	2.9	3.0	3.3	3.3	4.8	4.0	1.8	1.3	.8	2.0	2.1	2.5
22	2.9	3.1	3.3	3.3	4.9	3.9	1.8	1.3	1.3	2.0	2.1	2.5
23	3.0	3.0	3.2	3.3	4.8	3.9	1.7	1.4	1.4	2.0	2.1	2.5
24	3.1	3.0	3.2	3.4	4.4	3.7	1.5	1.5	1.1	2.0	2.2	2.5
25	3.0	3.0	3.1	3.6	4.5	3.6	1.5	1.5	1.4	2.0	2.2	2.4
26	2.9	3.0	3.2	4.1	4.6	3.5	1.5	1.0	1.2	2.0	2.2	2.4
27	2.9	3.1	3.4	4.2	4.6	3.5	1.5	1.2	1.3	2.0	2.2	2.7
28	2.9	3.1	3.4	4.5	4.5	3.4	1.5	1.0	1.3	2.0	2.3	2.7
29	2.9	.....	3.4	4.7	4.4	3.2	1.5	.8	1.4	2.0	2.3	2.6
30	2.9	.....	3.4	4.8	4.3	3.2	1.5	1.0	1.4	2.0	2.2	2.5
31	2.9	.....	3.3	.....	4.3	.....	1.4	.7	.....	2.0	.....	2.5

Station rating table for Carson River near Empire, Nev., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	3	2.10	77	3.10	313	4.10	765
1.10	4	2.20	93	3.20	347	4.20	825
1.20	6	2.30	110	3.30	384	4.30	889
1.30	8	2.40	129	3.40	423	4.40	956
1.40	12	2.50	150	3.50	464	4.50	1,026
1.50	16	2.60	173	3.60	508	4.60	1,100
1.60	23	2.70	197	3.70	554	4.70	1,180
1.70	31	2.80	223	3.80	603	4.80	1,260
1.80	40	2.90	251	3.90	654	4.90	1,345
1.90	51	3.00	281	4.00	708	5.00	1,430
2.00	63						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is well defined between gage heights 1.7 feet and 5.4 feet.

Estimated monthly discharge of Carson River near Empire, Nev., for 1905.

[Drainage area, 988 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	404	223	267	16,420	0.270	0.311
February	384	251	300	16,660	.304	.317
March	423	313	366	22,500	.370	.427
April	1,260	384	561	33,380	.568	.634
May	1,430	464	929	57,120	.940	1.08
June	1,100	347	728	43,320	.737	.822
July	347	12	95.4	5,866	.097	.112
August	16	0	6.9	424	.0070	.0081
September	12	0	5.5	327	.0056	.0062
October	63	12	45.8	2,816	.046	.053
November	110	63	78.1	4,647	.079	.088
December	197	93	135	8,301	.137	.158
The year	1,430	0	293	211,800	.280	4.02

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

SUSAN RIVER BASIN.

DESCRIPTION OF BASIN.

Susan River rises on the eastern slope of the Sierra Nevada in northeastern California, the rim of the basin having an elevation of 7,000 feet, flows eastward, and discharges into Honey Lake—one of the land-locked lakes of the Great Basin—at an elevation of about 4,000 feet.

The drainage basin is long and narrow, and though numerous small creeks enter the river from both the north and south there are no tributaries of any size. Willow Creek, which joins the stream about 12 miles below Susanville, is the most important.

In the upper reaches of the basin, at an elevation of about 6,000 feet, are numerous small lakes and this region has also good forest cover. Below Susanville, in the area surrounding Honey Lake, the soil deposit has considerable depth and is susceptible of high cultivation; elsewhere the basin is composed of lava rock with a thin covering of soil.

The summer flow of the stream is regulated by several small storage reservoirs, but these have inconsiderable capacity. There are, however, a number of good storage sites in the basin. The precipitation is mostly in the form of snow.

SUSAN RIVER NEAR SUSANVILLE, CAL.

This station was established June 3, 1900. It is located about three-fourths of a mile southwest of Susanville, at the electric-light plant.

The channel is straight for 150 feet above and 250 feet below the cable. The right bank is high and not liable to overflow and is composed of clay covered with vegetation. The left bank is low, is liable to overflow, and is covered with a sparse growth of willows. The bed of the stream is of gravel and cobblestone and is permanent. A short distance above the station a small irrigating ditch, known as the Masten ditch, is taken out on the right bank. There is a flume near its head in which a gage has been placed.

Discharge measurements are made by means of a cable and car. The initial point for soundings is a post in the fence in line with the cable. The cable support on the left bank is 34.8 feet from the initial point for soundings.

The gage is read once each day by James Branham. When the station was first established a temporary gage was installed on the right bank. December 20, 1903, the station at the electric-light plant was reestablished and a new gage was set which was made to read 2 feet more than the original gage. The gage is referred to bench marks as follows: (1) A nail in the fence post which is used as the initial point for soundings; elevation, 11.35 feet. (2) A nail in the cable post; elevation, 9.00 feet. (3) A nail in the cottonwood tree to which the cable is attached; elevation, 10.00 feet. Elevations are above zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 51, p 408; 66, pp 115-116; 85, p 123; 100, pp 204-205; 133, p 339-346.
Discharge: 51, p 408; 66, p 116; 100, p 205; 133, p 340.
Discharge, monthly: 75, p 190; 133, p 341-342.
Gage heights: 51, p 408; 66, p 116; 85, p 124; 100, p 205; 133, p 340.
Rating table: 566, p 175; 133, p 341.

Discharge measurements of Susan River near Susanville, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	J. Branham	44	92	4.79	6.60	441
May 12	do	29	48	3.27	5.40	157
June 12	do	25	31	2.32	4.70	72
June 25	do	24	18	1.66	4.20	30
July 23	do	18	10.8	1.19	3.85	12.8
August 29	do	14	8.1	0.85	3.75	6.9
September 26	do	19	13.6	1.13	4.00	15.4

Daily gage height, in feet, of Susan River near Susanville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.95	5.2	5.25	6.15	5.95	5.15	4.1	4.1	3.8	3.8	4.0	4.0
2	4.8	5.2	5.25	5.95	5.9	5.1	4.1	4.1	3.8	3.8	4.0	4.0
3	4.75	5.2	5.25	5.95	5.8	5.05	4.45	4.1	3.8	3.9	4.0	4.0
4	4.7	5.2	5.25	5.9	5.8	5.05	4.8	4.1	3.8	3.95	4.0	4.0
5	4.65	5.15	5.25	5.9	5.65	5.0	4.6	4.1	3.85	3.95	4.0	4.0
6	4.6	5.05	5.25	6.0	5.55	5.0	4.4	4.1	3.85	3.95	4.0	4.0
7	4.6	4.85	5.25	6.1	5.5	5.0	4.25	4.1	3.85	4.0	4.0	4.0
8	4.55	4.85	5.25	6.1	5.5	4.9	4.1	4.0	3.85	3.95	4.0	4.0
9	4.55	4.75	5.2	6.1	5.5	4.85	4.1	3.9	3.85	3.9	4.0	4.0
10	4.55	4.8	5.2	6.2	5.45	4.75	4.0	3.8	3.85	3.9	4.0	4.0
11	4.55	4.7	5.2	6.1	5.4	4.7	4.0	3.8	3.9	3.9	4.0	4.0
12	4.6	4.65	5.4	6.1	5.4	4.7	4.0	3.8	3.9	3.9	4.0	4.0
13	4.65	4.55	5.9	6.1	5.35	4.65	3.95	3.8	3.9	3.9	4.0	4.0
14	4.7	4.5	5.9	6.1	5.3	4.65	4.2	3.8	3.85	3.9	4.0	4.0
15	4.7	4.45	6.05	6.1	5.3	4.6	4.2	3.75	3.85	3.9	4.0	4.0
16	4.7	4.45	6.1	6.1	5.4	4.5	4.2	3.75	3.8	3.9	4.0	4.0
17	4.7	4.5	6.05	6.05	5.4	4.5	4.0	3.75	3.8	4.0	4.0	4.0
18	4.65	4.55	6.0	6.05	5.4	4.4	4.0	3.75	3.8	4.05	4.0	4.0
19	4.65	5.05	6.6	6.05	5.4	4.4	4.1	3.75	3.9	4.0	4.0	4.0
20	4.65	5.35	6.25	5.95	5.4	4.4	4.05	3.75	3.9	4.0	4.0	4.0
21	4.65	5.35	6.45	5.8	5.4	4.3	3.9	3.8	3.95	4.0	4.0	4.0
22	4.8	5.25	6.15	5.8	5.4	4.3	3.9	3.8	3.95	4.0	4.0	4.0
23	5.5	5.1	6.1	5.8	5.35	4.25	3.85	3.8	3.95	4.0	4.05	4.0
24	5.4	5.1	6.05	5.85	5.35	4.2	3.85	3.75	3.95	4.0	4.05	4.0
25	5.2	5.2	5.85	5.9	5.3	4.2	3.85	3.75	3.95	4.0	4.1	4.0
26	4.95	5.2	6.9	6.0	5.3	4.2	3.85	3.75	4.0	4.0	4.1	4.0
27	4.9	5.25	6.3	6.0	5.3	4.2	3.8	3.75	3.9	4.0	4.1	4.0
28	4.9	5.25	6.1	6.0	5.25	4.2	3.8	3.75	4.0	4.0	4.05	4.0
29	4.85	.....	6.0	6.0	5.25	4.15	3.75	3.8	3.95	4.0	4.05	4.0
30	4.8	.....	6.1	6.0	5.2	4.15	3.75	3.8	3.9	4.0	4.0	4.0
31	4.8	.....	6.0	.....	5.2	.....	4.1	3.8	.....	4.0	.....	4.0

Station rating table for Susan River near Susanville, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.75	7	4.60	59	5.40	152	6.20	307
3.80	9	4.70	68	5.50	168	6.30	331
3.90	13	4.80	77	5.60	185	6.40	356
4.00	18	4.90	87	5.70	203	6.50	382
4.10	24	5.00	98	5.80	222	6.60	410
4.20	30	5.10	110	5.90	242	6.70	440
4.30	37	5.20	123	6.00	262	6.80	470
4.40	44	5.30	137	6.10	284	6.90	500
4.50	51						

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904–5, and is well defined.

Estimated monthly discharge of Susan River near Susanville, Cal., for 1905.

[Drainage area, 256 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	168	55	76.9	4,728	0.300	0.346
February	144	48	96.9	5,382	.379	.395
March	500	123	234	14,390	.914	1.05
April	307	222	264	15,710	1.03	1.15
May	252	123	160	9,838	.625	.721
June	116	27	61.3	3,648	.239	.267
July	77	7	23.4	1,439	.091	.105
August	24	7	12.1	744	.047	.054
September	18	9	12.3	732	.048	.054
October	21	9	15.7	965	.061	.070
November	24	18	19.0	1,131	.074	.083
December	18	18	18.0	1,107	.070	.081
The year	500	7	82.8	59,810	.323	4.38

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

WILLOW CREEK AT MERRILLVILLE, CAL.

Willow Creek rises from springs directly under Eagle Lake, presumably seepage from Eagle Lake, which has no surface outlet; it flows southward, joining Susan River about 12 miles below Susanville. Its only tributary of importance is Petes Creek, which drains a large area in the eastern portion of the basin. The drainage area of the main stream has good timber covering, while that tributary to Petes Creek is barren of timber. The entire basin is composed of lava rock with a light covering of soil, and contains large stretches of barren table-lands with scattered peaks of volcanic origin. There is a large area of cultivated land along Willow Creek above the gaging station at Standish and considerable water is diverted for irrigation of lands adjoining the stream.

The gaging station at Merrillville was established June 18, 1904. It is located near the head of the creek, at the old bridge, 100 feet above the present wagon bridge, on the road from Merrillville to Eagle Lake.

The channel is straight above and below the bridge for a distance of 100 feet. The banks are low, but as there is very little fluctuation in the discharge of the creek, they are not subject to overflow. The bed of the stream is composed of gravel, and is comparatively permanent.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank of the stream. The distance across the creek is marked on the footbridge at intervals of 2 feet.

The gage, which is read once each day by R. W. Hurlburt, is a 2 by 4 inch vertical rod fastened to the left end of the bridge.

A description of this station, gage height, discharge data, and rating table are contained in Water-Supply Paper No. 133, of the United States Geological Survey, pp. 339–341.

Daily gage height, in feet, of Willow Creek at Merrillville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.1	0.95	1.1	0.9	0.95	0.9	0.95	1.0	1.1	1.3	1.25
2	1.05	1.1	1.0	1.05	.9	.95	.9	.95	1.0	1.1	1.25	1.3
3	1.0	1.1	1.0	1.0	.95	.95	.9	.95	1.0	1.1	1.2	1.3
4	1.0	1.05	1.0	1.0	.95	.95	.9	.95	1.0	1.1	1.2	1.3
5	1.0	1.1	.95	1.0	.95	.95	.9	.95	1.0	1.1	1.2	1.3
6	1.0	1.05	.95	1.0	.95	.95	.9	.95	1.0	1.2	1.2	1.3
7	1.0	1.0	1.0	1.0	.95	.95	.9	.95	1.0	1.3	1.2	1.3
8	1.0	1.0	1.05	1.0	.95	1.0	.9	.95	1.0	1.2	1.2	1.3
9	1.0	1.0	1.0	1.0	.95	1.0	.9	1.0	1.0	1.2	1.2	1.3
10	1.0	1.0	1.0	.95	1.0	.95	.95	1.0	1.0	1.2	1.2	1.3
11	1.0	1.0	1.0	.95	1.05	.95	.95	1.0	1.0	1.2	1.2	1.3
12	1.0	1.0	1.0	.95	1.1	.95	1.05	1.0	1.0	1.2	1.2	1.3
13	1.0	1.0	1.05	1.0	1.05	.95	1.05	1.0	1.0	1.2	1.2	1.3
14	1.05	1.0	.95	1.0	1.0	.95	1.0	1.0	1.0	1.2	1.2	1.3
15	1.05	.95	1.05	1.0	.95	.95	1.0	1.0	1.0	1.2	1.2	1.3
16	1.05	1.0	1.1	1.0	.9	.95	1.0	1.0	1.0	1.2	1.2	1.3
17	1.05	1.0	1.1	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
18	1.05	1.0	1.05	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
19	1.05	1.25	1.1	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
20	1.0	1.15	1.05	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
21	1.05	1.05	1.05	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
22	1.1	1.05	1.05	1.0	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
23	1.1	1.05	1.05	.9	.95	.95	.95	1.0	1.05	1.25	1.2	1 3
24	1.1	1.0	1.0	.9	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
25	1.05	1.0	1.0	.95	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
26	1.0	1.05	1.1	.95	1.0	.95	.95	1.0	1.05	1.2	1.2	1.3
27	1.0	1.0	1.1	.95	1.0	.95	.95	1.0	1.1	1.2	1.2	1.3
28	1.0	1.0	1.0	.95	1.0	.95	.95	1.0	1.15	1.2	1.25	1.3
29	1.0	.....	1.1	.9	.95	.95	.95	1.0	1.2	1.2	1.25	1.3
30	1.0	.....	1.05	.9	.95	.9	.95	1.0	1.1	1.2	1.25	1.3
31	1.0	.....	1.05	.....	.95	.....	.95	1.0	.....	1.25	.....	1.3

Station rating table for Willow Creek at Merrillville, Cal., from July 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	16	1.10	20	1.20	22	1.30	24
1.00	18						

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1904. It is fairly well defined.

Estimated monthly discharge of Willow Creek at Merrillville, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	20	18	18.5	1,138
February	23	17	18.8	1,044
March	20	17	18.6	1,144
April	20	16	17.6	1,047
May	20	16	17.1	1,051
June	18	16	17.0	1,012
July	19	16	16.9	1,039
August	18	17	17.7	1,088
September	22	18	18.7	1,113
October	24	20	21.9	1,347
November	24	22	22.2	1,321
December	24	23	24.0	1,476
The year	24	16	19.1	13,830

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

WILLOW CREEK NEAR STANDISH, CAL.

This station was originally established June 4, 1900. It was reestablished January 1, 1905, and discontinued December 31, 1905. It is located at the bridge on the road from Susanville to Hot Springs and is about 1½ miles above the junction of the creek with Susan River. It is about 4 miles west of north from Standish.

The channel is straight for 300 feet above and 250 feet below the station. The right bank is rather low and is subject to overflow at extreme high water; the left bank is high and not liable to overflow. The stream bed is sandy and liable to shift somewhat.

Discharge measurements are made from the bridge. The initial point for soundings is on the end of the bridge on the left bank, the bridge being marked at 5-foot intervals across the stream.

The gage, which is read once each day by T. E. Ravenscroft, a farmer who lives near the station, is a 4 by 4-inch vertical timber and is fastened to the left abutment of the bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 51, p 407; 66, p 115.
Discharge: 51, p 407.
Gage heights: 51, p 407; 66, p 115.

Discharge measurements of Willow Creek near Standish, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet*
January 24	J. Branham	57	117	0.80	6.15	94
January 29	do	57	87	.79	5.35	69
February 26	do	57	105	.79	5.75	83
April 23	do	32	21	.95	4.00	20
November 19	do	57	56	.61	4.80	34

Daily gage height, in feet, of Willow Creek near Standish, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.6	6.8	5.0	5.5	4.0	4.0	3.0	4.0	4.2	5.0	5.0	5.0
2	6.6	6.7	4.8	5.3	4.0	4.0	3.0	4.0	4.5	4.8	5.1	5.3
3	5.0	5.9	4.0	5.0	4.0	4.0	3.0	4.0	4.4	4.6	5.0	5.2
4	5.0	.....	4.0	5.0	4.0	4.0	6.0	4.0	4.4	4.3	5.0	5.0
5	4.6	5.8	4.0	4.8	4.0	4.0	5.8	4.0	4.4	4.0	5.0	5.1
6	4.6	6.0	4.4	4.5	4.0	4.0	4.8	4.0	4.4	4.0	5.1	5.0
7	4.6	6.0	4.4	4.0	4.0	4.0	4.0	4.0	4.4	4.0	5.2	5.2
8	4.6	5.8	4.4	4.0	4.0	4.2	4.0	4.0	4.4	4.2	5.0	4.1
9	4.6	5.6	4.0	4.0	4.0	4.1	4.0	4.0	4.4	4.2	5.0	4.1
10	4.6	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.1	5.2	4.4
11	4.6	5.0	4.4	4.0	4.2	4.0	4.0	4.2	4.0	4.1	5.1	4.4
12	4.7	5.0	4.0	3.8	4.2	4.0	6.0	4.0	4.0	4.0	4.6	4.4
13	4.7	5.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.4	4.3
14	4.7	5.0	4.0	4.0	4.0	4.0	5.8	4.0	6.0	4.0	4.4	4.5
15	5.8	4.6	4.4	4.0	4.0	4.0	5.0	4.0	5.8	4.0	4.4	4.1
16	5.8	4.7	4.4	4.0	4.0	4.0	5.8	4.0	5.0	4.1	4.6	4.1
17	6.0	4.7	4.4	4.0	4.0	4.0	5.8	4.0	5.0	4.5	4.8	4.3
18	6.0	4.7	4.4	4.0	4.0	4.0	5.8	4.2	5.0	4.5	4.8	4.3
19	6.4	5.1	5.0	4.0	4.0	4.0	6.0	4.2	5.0	4.5	5.0	4.3
20	6.35	6.0	5.0	4.0	4.0	4.0	6.0	4.6	5.0	4.5	5.0	4.3
21	6.0	7.8	5.2	4.0	4.1	4.0	6.0	4.5	4.8	4.5	4.8	4.0
22	7.6	7.8	5.2	4.0	4.1	4.0	5.0	4.6	4.8	4.5	4.6	5.0
23	7.8	7.0	5.0	4.0	4.0	4.0	5.0	4.2	4.8	5.0	4.6	5.0
24	6.0	6.2	4.8	4.0	4.0	4.0	4.8	4.0	4.6	5.1	4.5	5.2
25	6.0	6.0	4.6	4.0	4.0	4.0	4.1	4.0	4.5	5.2	4.4	5.0
26	5.8	6.3	5.3	4.0	4.0	6.2	4.0	4.2	5.0	5.2	4.8	5.2
27	5.6	5.0	5.0	4.0	4.0	5.0	4.0	4.2	6.0	5.1	4.8	5.3
28	5.6	5.0	5.0	4.0	3.8	4.0	4.0	4.2	5.8	5.5	5.0	5.3
29	5.7	.....	5.0	4.0	3.8	4.0	4.0	4.2	5.8	5.2	5.0	5.3
30	5.0	.....	5.0	4.0	3.8	3.6	4.0	4.3	5.0	5.0	5.0	5.3
31	5.6	.....	5.5	.....	.....	.....	4.0	4.2	.....	5.0	.....	5.3

Station rating table for Willow Creek near Standish, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	10	4.70	34	5.80	86	6.90	165
3.70	11	4.80	37	5.90	92	7.00	173
3.80	13	4.90	41	6.00	98	7.10	181
3.90	15	5.00	45	6.10	105	7.20	189
4.00	17	5.10	49	6.20	112	7.30	197
4.10	19	5.20	54	6.30	119	7.40	205
4.20	21	5.30	59	6.40	126	7.50	213
4.30	23	5.40	64	6.50	133	7.60	221
4.40	25	5.50	69	6.60	141	7.70	229
4.50	28	5.60	74	6.70	149	7.80	238
4.60	31	5.70	80	6.80	157		

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 between gage heights 4 feet and 6.15 feet. It is not well defined.

Estimated monthly discharge of Willow Creek near Standish, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	238	31	80.4	4,944
February	238	31	89.4	4,965
March	69	17	33.5	2,060
April	69	17	22.9	1,363
May	21	13	17.0	1,045
June	112	10	21.1	1,256
July	98	0	46.2	2,841
August	31	17	19.6	1,205
September	98	17	41.0	2,440
October	69	17	31.8	1,955
November	54	25	39.6	2,356
December	59	17	38.7	2,380
The year	238	0	40.1	28,810

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

OWENS RIVER DRAINAGE BASIN.

Owens River has its source in the Sierra Nevada, in eastern California, and flows southeastward, parallel with this range, finally discharging its waters into Owens Lake. This basin has a length from north to south of approximately 150 miles and a width of from 20 to 25 miles. It lies between the Sierra Nevada on the west and the White Mountains on the east. Practically the entire flow of this river is derived from the Sierra Nevada, as it drains the eastern slope of this range from Mount Lyell, on the north, to a point some distance below Mount Whitney, on the south. The White Mountains furnish no water for this stream except in times of very heavy rain storms, which seldom occur on this range. Numerous tributaries enter Owens River from the west, which have their sources in the high elevations of the Sierra Nevada, extending from the northern to the southern limits of this basin. The topography of that portion of the Sierra Nevada which is drained by this stream is extremely rough and precipitous, the mountains rising abruptly from Owens Valley to elevations of 13,000 to 14,000 feet. The rock formation is of granite, with very little soil covering, and sparse timber growth. Numerous lakes and marshes lie in the upper reaches of this portion of the drainage basin. Owens River, a short distance below its source, enters a flat, swampy country known as Long Valley, where a considerable quantity of its flow is used for the irrigation of meadow lands for stock raising. This water returns to the river channel at the lower end of Long Valley, where the stream enters a deep, narrow gorge with heavy grade. As the river breaks from this canyon it enters Owens Valley, through which it flows for about 80 miles, finally discharging into Owens Lake. The gaging station at Round Valley is located at the lower end of this canyon. Below this point numerous diversions are made for the irrigation of land in Owens Valley, where the soil is extensively cultivated, and large areas are used for raising hay and grain. This country is particularly adapted to stock raising, which is carried on to a large extent throughout the valley. There are numerous opportunities for the construction of storage reservoirs within this basin, both on the main stream and on the upper reaches of its tributaries, though none have been constructed as yet. The precipitation is extremely light within the area of the basin, except on the high elevations of the Sierra Nevada, where there is a heavy fall of snow. The melting of the snow in spring and summer feeds the numerous tributaries of this river, insuring a continued flow throughout the year.

The results of data collected in Owens River Valley are contained in Water-Supply Paper No. 177, which presents the results of all the hydrographic data collected in the State of California during 1905.

MINOR GREAT BASIN DRAINAGE.

PRINCIPAL STREAMS.

The minor Great Basin drainage includes large areas in Oregon, Nevada, Utah, and California, in which the water supply is very limited, most of the streams being intermittent.

The work of the United States Geological Survey on this drainage in 1905 covered only the collection of data concerning streams in Oregon, which are here classified by the lakes into which they flow, as follows: Silvies River, discharging into Malheur Lake; Silver Creek, into Harney Lake; Silver Creek, Bridge Creek, and Bear Creek, into Silver Lake; Summer Lake and Ana River, into Summer Lake; and Chewaucan River, into Abert Lake.

MALHEUR LAKE BASIN.

MALHEUR LAKE AT THE NARROWS, OREGON.

This station was established May 14, 1903. It is located at the highway bridge across The Narrows. The station is maintained for the purpose of obtaining data in regard to the fluctuations of the lake, which has no outlet.

The gage is a 1 by 4 inch board, 10 feet long, fastened to a telegraph pole. It is read from the bridge once each week by R. J. Haines, the postmaster. The bench mark is a United States Geological Survey standard iron bench-mark post, set at the east end of the bridge, on the south side of the road, near the fence and about 200 feet from the gage; its elevation is 8.20 feet above the zero of the gage and 4,088 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 429; 133, pp 344-345.
Gage heights: 100, p 430; 133, p 345.

Gage height, in feet, of Malheur Lake, at The Narrows, Oregon, for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
2				4.2			2.7
4						3.0	
5			5.0				
7					3.45		
8		5.65					
9				4.0			2.65
11						2.9	
12			4.8				
14					3.3		
15		5.5					
16	5.7			3.85			2.65
18						2.8	
19			4.6				
21					3.2		
22		5.35					
23				3.6			
25						2.75	
26			4.4				
28					3.1		
29		5.2					
30				3.5			

SILVIES RIVER NEAR SILVIES, OREG.

Silvies River rises at Soda Spring, in southern Grant County, Oreg., flows southwest, then southeast, and discharges into the north end of Malheur Lake.

A temporary station was established near Silvies, Oreg., May 8, 1903, and gage heights were read by John Craddock from May 8 to June 26, 1903. One discharge measurement was made at the temporary station. June 16, 1903, a permanent gage was established at the proposed dam site one-half mile below the temporary gage, 2 miles west of the stage road, and three-fourths of a mile below the mouth of Trout Creek. There is a dam 1½ mile upstream.

The channel is straight for 150 feet above and 200 feet below the station. The right bank is low, and will overflow at high water for a considerable distance; the left bank is high and rocky, and not liable to overflow. The bed of the stream is composed of gravel, is free from vegetation, and shifts somewhat. All the water passes beneath the cable at all stages.

Discharge measurements are made from a five-eighth inch galvanized-iron cable, with a span of 494 feet, located 75 feet downstream from the gage. It is supported in the center. The initial point for soundings is the zero of the tagged wire, 29 feet from the cable support.

The gage is an inclined 2 by 6 inch plank on the left bank. No bench marks have been established.

This station was not maintained regularly during 1905, but a few discharged measurements were made when measurements were made at Burns, a station on the same stream below this point.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 100, p 434; 133, pp 345-346.
Discharge: 100, p 434; 133, p 346.
Discharge, monthly: 100, p 436; 133, p 348.
Gage heights: 100, p 435; 133, p 347.
Rating table: 100, p 435; 133, p 347-348.

Discharge measurements of Silvies River, near Silvies, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 23	M. L. Lewis	47	174	0.96	4.55	166
April 13	do	47	165	.95	4.65	156
April 26	do	48	178	1.08	4.82	193
May 25	do	43	135	.70	3.90	94
October 24	do	18	6.5	.63	2.00	4.1

SILVIES RIVER NEAR BURNS, OREG.

This station was established as a temporary station May 10, 1903, and was made permanent August 14, 1903. A new gage and a cable for discharge measurements were installed January 19, 1904. The station is located about 10 miles above Burns, Oreg.

The channel is straight for 75 feet above and below the cable. The right bank is low, and is liable to overflow for a considerable distance. The left bank is high and rocky, and will not overflow. Both banks have been cleared of brush. At the gage the bed of the stream is composed of clean sand and gravel. There is but one channel at low water; at high stages there are two or more channels. All the waters passes beneath the cable at all stages.

Discharge measurements are made from a five-eighths inch galvanized-iron cable, with a span of 390 feet, located at Lampshir's place, 1 mile above the gage. In addition to the timber supports at the ends, the cable is supported at a point 167 feet from the initial

point for soundings by a tree 10 inches in diameter. The initial point for soundings is the zero of the tagged wire, 22½ feet from the lower end of the turnbuckle. At low water, when the current is sluggish, discharge measurements are made by wading.

The gage, which is read once each day by Leonia Parker, is located 10 feet below the bridge near Parker's house. It is in two sections, both consisting of 2 by 6 inch timbers supported by a frame secured to the bank. The lower section is inclined and reads from 2 to 12.6 feet; the upper section is vertical and reads from 12.7 to 17 feet. The new gage has the same datum as the old one which it replaced. The bench mark is the highest point of a large rock on the right bank, directly across the river from the gage, from which it is 135 feet distant; elevation above zero of gage, 19.76 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 431–432; 133, pp 348–349.
Discharge: 100, p 432; 133, p 349.
Discharge, monthly: 100, p 433; 133, p 351.
Gage heights: 100, pp 432–433; 133, p 350.
Rating table: 100, p 433; 133, p 351.

Discharge measurements of Silvies River near Burns, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	M. L. Lewis	56	476	0.95	7.55	450
April 11	do	55	466	.87	7.70	405
April 25	do	55	438	.80	6.65	352
May 17[a]	do	57	520	.36	4.75	190
July 18	Ivan Landes	28	22	.89	2.54	20
October 3	M. L. Lewis	25	17	.78	2.40	13.4

[a] Water at cable backed up by dam one-half mile below, but no effect on gage height.

Daily gage height, in feet, of Silvies River near Burns, Oreg., for 1905.

Day.	Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	2.9	.....	6.8	3.8	2.8	2.4	2.3	2.4	2.5	2.5
2	3.9	2.9	.....	6.5	3.8	2.8	2.4	2.3	2.4	2.5	2.5
3	3.4	2.9	.....	6.3	3.9	2.8	2.4	2.3	2.4	2.5	2.5
4	3.3	2.9	.....	6.25	3.9	2.8	2.4	2.3	2.4	2.5	2.5
5	3.1	2.9	.....	6.2	3.9	2.8	2.4	2.3	2.4	2.5	2.5
6	2.9	2.9	.....	6.0	3.9	2.8	2.4	2.3	2.4	2.5	2.5
7	2.8	.....	.....	5.9	3.9	2.8	2.4	2.3	2.4	2.5	2.5
8	2.7	.....	.....	5.2	3.8	2.6	2.4	2.3	2.4	2.5	2.5
9	2.7	.....	8.3	5.3	3.8	2.6	2.35	2.3	2.4	2.5	2.5
10	2.7	.....	8.0	5.4	3.8	2.6	2.35	2.3	2.4	2.5	2.5
11	2.7	.....	7.75	5.6	3.[illegible]	2.6	2.35	2.3	2.4	2.5	2.5
12	2.7	.....	7.35	5.6	3.5	2.6	2.3	2.3	2.4	2.5	2.5
13	2.7	.....	7.15	5.6	3.4	2.6	2.3	2.3	2.4	2.55	2.5
14	2.7	.....	7.05	5.5	3.4	2.6	2.3	2.3	2.4	2.55	2.5
15	.....	.....	6.65	5.0	3.4	2.6	2.3	2.3	2.4	2.55	2.5
16	.....	.....	6.65	4.9	3.3	2.6	2.3	2.3	2.4	2.55	2.5
17	.....	.....	6.9	4.8	3.3	2.6	2.3	2.3	2.4	2.55	2.45
18	.....	.....	7.0	4.4	3.2	2.6	2.3	2.3	2.4	2.55	2.45
19	.....	.....	7.0	4.2	3.2	2.55	2.3	2.3	2.4	2.55	2.4
20	.....	.....	7.0	4.2	3.0	2.55	2.3	2.3	2.4	2.5	2.4
21	.....	.....	7.2	4.2	3.0	2.5	2.3	2.3	2.4	2.5	2.4
22	.....	.....	7.3	4.2	2.9	2.5	2.3	2.3	2.4	2.5	2.4
23	.....	.....	7.15	4.2	2.8	2.55	2.3	2.3	2.4	2.5	2.4

Daily gage height, in feet, of Silvies River near Burns, Oreg., for 1905—Continued.

Day.	Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
24	.....	.....	7.0	4.1	2.8	2.55	2.3	2.3	2.4	2.5	2.4
25	.....	.....	7.2	4.1	2.8	2.5	2.3	2.3	2.45	2.5	2.4
26	.....	.....	7.3	4.0	2.8	2.4	2.3	2.3	2.5	2.5	2.4
27	.....	.....	7.5	4.0	2.8	2.4	2.3	2.3	2.5	2.5	2.4
28	.....	.....	7.5	3.9	2.8	2.4	2.3	2.3	2.5	2.5	2.4
29	2.9	.....	7.3	3.8	2.8	2.4	2.3	2.3	2.5	2.5	2.4
30	2.9	.....	6.8	3.8	2.8	2.4	2.3	2.4	2.5	2.5	2.4
31	2.9	.....	.....	3.8	.....	2.4	2.3	.....	2.5	.....	2.4

NOTE.—Ice conditions are known to exist frequently during the winter months.

Station rating table for Silvies River near Burns, Oreg., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	9	3.90	116	5.40	242	6.90	376
2.40	13	4.00	124	5.50	250	7.00	385
2.50	18	4.10	132	5.60	259	7.10	394
2.60	23	4.20	140	5.70	268	7.20	404
2.70	29	4.30	148	5.80	277	7.30	414
2.80	35	4.40	156	5.90	286	7.40	424
2.90	42	4.50	165	6.00	295	7.50	434
3.00	49	4.60	173	6.10	304	7.60	444
3.10	56	4.70	181	6.20	313	7.70	454
3.20	63	4.80	190	6.30	322	7.80	464
3.30	70	4.90	198	6.40	331	7.90	474
3.40	77	5.00	207	6.50	340	8.00	484
3.50	85	5.10	216	6.60	349	8.10	494
3.60	92	5.20	224	6.70	358	8.20	504
3.70	100	5.30	233	6.80	367	8.30	514
3.80	108						

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during the year. It is well defined between gage heights 2.4 feet and 7.5 feet.

Estimated monthly discharge of Silvies River near Burns, Oreg., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January (17 days)	116	29	47.7	1,808
February 1-6	42	42	42.0	500
April 9-30	514	353	408	17,800
May	367	108	205	12,600
June	116	35	73.8	4,39[illegible]
July	35	13	22.9	1,408
August	13	9	10.2	627
September	13	9	9.1	542
October	18	13	14.0	861
November	20	18	18.5	1,101
December	18	13	15.7	965
The period	.....	.....	.....	42,400

NOTE.—Open-channel rating table applied to the winter months without correction. January and February estimates subject to considerable error.

HARNEY LAKE BASIN.

SILVER CREEK, NEAR RILEY, OREG.

Silver Creek rises in the extreme northwestern part of Harney County, Oreg., and flows southeastward into the north end of Harney Lake.

The gaging station was established April 19, 1904. It is located 12 miles above Riley, Oreg., on the Burns-Shaniko stage line, and is 6 miles below the proposed reservoir site on Silver Creek.

The channels are straight for about 80 feet above and 50 feet below the station. There are three channels at high water and four or more at extreme floods. Both banks are low, covered with sagebrush, and subject to overflow. The bed of the stream is composed of sandy clay, is free from vegetation, and is shifting.

Discharge measurements are made from the three bridges over the three channels of the stream, in the line with the gage, and at high stages an additional slough is measured by wading. The initial point for soundings is the west end of the floor at each of the bridges.

The gage, which was read during 1905 by R. M. Cantrell and Miss Amy Bradford, is located at bridge No. 3, crossing the east or main channel of the creek. It is a plain staff gage, attached vertically to timbers on the lower side of the bridge at the left bank. From April 19 to September 10, 1904, when the permanent gage was established, readings were obtained by measuring down to the water surface from a mark on the bridge floor with a rod so graduated as to give gage readings direct. The bench mark is a United States Geological Survey standard iron bench-mark post on the north side of the road in front of the house of the observer. It is 20.19 feet above the zero of the gage and 4,345 feet above sea level, datum H. The top of the floor of bridge No. 1 at the 21-foot mark is 4,339.87 feet above sea level and 15.06 feet above the zero of the gage. The top of the floor of bridge No. 2 at the 20-foot mark is 4,338.69 feet above sea level and 13.88 feet above the zero of the gage. The top of the floor of bridge No. 3 at the 30-foot mark is 4,339.81 feet above sea level and 15.00 feet above the zero of the gage.

A description of this station, gage height, and discharge data, and rating table are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 352–354.

Discharge measurements of Silver Creek near Riley, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 14	M. L. Lewis	54	135	1.33	8.20	179
March 15	do	64	132	1.25	8.10	165
April 6	do	48	114	1.26	7.70	144
April 16	do	45	86	1.24	7.00	107
April 23	do	40	81	1.29	6.90	105
May 23	do	32	44	.83	5.65	36
July 21	King and Landes	4.5	1.2	1.33	4.45	1.6
October 13	M. L. Lewis	2.0	.73	1.30	4.50	.95

Daily gage height, in feet, of Silver Creek near Riley, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Oct.	Dec.
1	5.0	5.4	5.9	6.9	6.8	5.3	4.75	3.75	.....
2	.....	5.4	6.0	7.0	6.65	5.25	.....	4.2	.....
3	5.0	5.4	6.0	.....	6.6	5.25	4.7	4.45	.....
4	5.0	5.4	6.0	7.1	6.55	.....	4.7	4.4	.....
5	5.0	5.3	6.1	7.2	6.5	5.25	4.7	4.3	.....
6	5.0	.....	.....	7.7	6.4	5.25	4.7	4.45	.....
7	5.0	5.0	6.8	7.8	.....	5.25	4.65	4.7	.....
8	5.0	5.0	6.6	7.9	6.45	5.2	4.6	.....	.....
9	.....	5.0	7.0	7.9	6.45	5.2	.....	.....	.....
10	5.0	5.0	7.0	.....	6.4	5.2	.....	.....	.....
11	5.0	5.0	7.5	7.5	6.4	.....	.....	.....	.....
12	5.0	5.0	7.9	7.2	6.2	5.2	.....	.....	.....
13	5.0	.....	.....	7.1	6.0	5.1	.....	.....	.....
14	6.7	5.0	8.2	7.0	.....	5.0	.....	.....	.....
15	9.0	5.0	8.1	6.9	5.8	5.0	.....	.....	.....
16	.....	5.0	8.0	6.8	5.8	5.0	.....	.....	.....
17	6.4	5.0	8.8	.....	5.8	5.0	.....	.....	.....
18	6.3	5.0	8.9	6.7	5.8	.....	.....	.....	.....
19	6.0	5.0	8.5	6.7	5.7	4.95	.....	.....	.....
20	6.0	.....	.....	7.0	5.7	4.95	.....	.....	.....
21	5.8	7.8	8.1	6.9	.....	4.95	.....	.....	.....
22	6.8	7.7	8.0	6.95	5.6	4.9	.....	.....	.....
23	.....	7.0	7.9	6.9	5.55	4.9	.....	.....	.....
24	8.6	7.4	7.8	.....	5.5	4.9	.....	.....	.....
25	7.7	6.4	7.5	6.8	5.45	.....	.....	.....	5.1
26	6.4	6.0	7.5	7.0	5.45	4.9	.....	.....	5.1
27	6.4	.....	.....	7.05	5.45	4.85	.....	.....	5.1
28	6.0	6.2	7.4	6.9	.....	4.85	.....	.....	5.1
29	5.8	.....	7.4	6.8	5.3	4.85	.....	.....	5.1
30	.....	.....	6.8	6.7	5.3	4.85	.....	.....	5.1
31	5.5	.....	6.7	.....	5.3	.....	.....	.....	5.1

Station rating table for Silver Creek near Riley, Oreg., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.20	0.0	5.40	26	6.60	83	7.70	145
4.30	.2	5.50	30	6.70	89	7.80	151
4.40	.6	5.60	34	6.80	94	7.90	157
4.50	1.0	5.70	38	6.90	99	8.00	163
4.60	3	5.80	42	7.00	105	8.10	169
4.70	6	5.90	47	7.10	111	8.20	175
4.80	8	6.00	52	7.20	116	8.30	181
4.90	11	6.10	57	7.30	122	8.40	188
5.00	14	6.20	62	7.40	127	8.50	195
5.10	17	6.30	67	7.50	133	8.60	202
5.20	20	6.40	73	7.60	139	8.70	209
5.30	23	6.50	78				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined.

Estimated monthly discharge of Silver Creek near Riley, Oreg., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	230	14	58.8	3,616
February	151	14	41.9	2,327
March	223	47	128	7,870
April	157	89	110	6,545
May	94	23	51.0	3,136
June	23	10	15.5	922
The period				24,020

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction. Discharge interpolated on days when gage was not read. Records fragmentary after July 8, as there was no regular observer. Creek was dry in August, September, and the greater part of July.

SILVER LAKE BASIN.

SILVER CREEK NEAR SILVERLAKE, OREG.

Silver Creek rises in the western part of Lake County, Oregon, flows northward to Pauline Lake and Marsh, then turns abruptly to the southeast and enters Silver Lake.

The gaging station was established December 29, 1904. It is located 0.9 mile above the county bridge, 1.6 miles southwest of Silver Lake, Oreg.

The channel is straight for 100 feet above and 75 feet below the cable. Both banks are high, rocky, clean, and not subject to overflow. The bed of the stream is composed of rock and gravel, is free from vegetation, and is permanent. There is but one channel at all stages. The current is swift.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire, directly at the gage. The initial point for soundings is 9.2 feet west from the anchor bolt on the east end of the cable.

The gage, which was read during 1905 once each day by Henry Egli, is an inclined staff, set on the right bank. The bench mark is a copper bolt cemented in the solid rock on the east side of the stream, 43 feet downstream from the cable, and 12 feet from the edge of low water; elevation above zero of gage, 8.12 feet.

Discharge measurements of Silver Creek near Silver Lake, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 21	I. Landes	21	26	0.98	1.00	25
February 23	do	22	34	1.50	1.35	51
March 17	do	21	41	1.82	1.70	74
April 8	do	22	44	2.26	1.90	100
May 7	do	21	33	1.45	1.30	48
May 31	do	21	28	1.24	1.10	34
June 14 [a]	do	18	19	1.30	.99	24
August 7 [b]	do	10	9.2	2.17	.79	20
October 4 [c]	do	10	8.1	1.83	.74	14.8
October 24 [d]	do	9	9.8	2.12	.74	21
November 10	do	10	9.9	2.22	.93	22
November 24	do	9.5	9.2	1.59	.73	14.8
December 21 [e]	do	9.5	8.3	.95	.60	7.9

[a] Measurements made about 16 feet above cable; meter on rod.
[b] Measurements made about 40 feet above cable; meter on rod.
[c] Measurements made about 50 feet above cable; meter on rod.
[d] Measurements made about 50 feet above cable; meter on cable.
[e] Ice about 5 inches thick.

Daily gage height, in feet, of Silver Creek near Silver Lake, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	1.0	1.5	1.5	1.8	1.05	0.9	0.8	0.8	0.75	0.8	0.8
2	1.0	1.0	1.7	2.45	1.65	1.0	.85	.85	.75	.75	.75	.7
3	1.05	1.0	1.7	2.4	1.4	1.1	.85	.8	.75	.75	.75	.7
4	1.0	.95	1.6	2.4	1.3	1.2	.85	.8	.75	.75	.75	.7
5	.95	.95	1.5	2.8	1.4	1.15	.8	.8	.75	.75	.75	.7
6	.95	.95	1.85	2.5	1.3	1.1	.75	.8	.75	.8	.85	.75
7	1.0	.9	1.8	2.0	1.3	1.15	.7	.8	.75	.9	.95	.7
8	1.0	1.3	1.6	1.95	1.35	1.2	.7	.8	.75	.85	1.2	.75
9	1.0	1.2	1.4	1.7	1.65	1.1	.7	.8	.75	.85	1.2	.75
10	.95	1.1	1.45	1.75	1.35	1.05	.75	.8	.75	.8	1.25	.9
11	.95	1.0	1.6	1.6	1.4	1.05	.75	.75	.75	.75	1.2	1.0
12	1.25	1.05	1.55	1.5	1.7	1.0	.8	.8	.75	.75	1.2	1.0
13	1.25	1.05	1.55	1.75	1.55	1.0	.8	.8	.75	.75	1.15	1.05
14	1.5	1.0	1.5	1.5	1.4	1.0	.8	.8	.75	.75	.95	1.0
15	1.6	1.0	1.4	1.4	1.3	1.0	.8	.8	.75	.75	1.05	1.0
16	1.5	1.0	1.55	1.4	1.25	1.0	.8	.8	.75	.75	.85	1.0
17	1.25	1.1	1.7	1.3	1.25	1.0	.8	.8	.75	.8	.85	1.0
18	1.2	1.3	1.5	1.55	1.25	1.0	.8	.8	.75	.8	.8	1.0
19	1.1	1.05	1.5	1.5	1.2	.95	.8	.8	.75	.75	.8	.85
20	1.0	2.0	1.65	1.4	1.15	.95	.8	.85	.75	.75	.85	.85
21	1.0	2.25	1.55	1.4	1.2	.95	.8	.85	.75	.75	.75	.8
22	1.0	1.4	1.6	1.5	1.15	.95	.8	.8	.8	.75	.75	.8
23	1.05	1.8	1.6	2.0	1.1	.95	.8	.8	.75	.75	.75	.7
24	1.45	1.4	1.75	1.9	1.05	1.0	.8	.8	.75	.75	.75	.95
25	1.6	1.2	1.9	1.85	1.0	.95	.8	.8	.75	.75	.75	1.1
26	1.35	1.4	2.4	2.1	1.1	.95	.8	.8	.75	.75	.7	1.15
27	1.2	1.5	2.2	1.85	1.2	.9	.8	.8	.85	.75	.7	1.0
28	1.2	1.55	1.7	1.4	1.2	.9	.8	.8	.8	.75	.7	.9
29	1.1	.....	1.5	1.65	1.2	.9	.8	.8	.8	.75	.75	.9
30	1.05	.....	1.4	1.5	1.15	.9	.8	.8	.75	.75	.75	.9
31	1.05	.....	1.4	.....	1.1	.....	.8	.8	.....	.75	.....	1.15

Station rating table for Silver Creek near Silver Lake, Oreg., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.75	15	1.00	27	1.50	62	2.00	107
0.80	17	1.10	33	1.60	70	2.10	119
0.85	19	1.20	39	1.70	78	2.20	131
0.90	21	1.30	46	1.80	87	2.30	143
0.95	24	1.40	54	1.90	97	2.40	155

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is well defined between gage heights 0.7 foot and 2 feet.

Estimated monthly discharge of Silver Creek near Silver Lake, Oreg., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	70	24	36.8	2,263
February	137	21	43.9	2,438
March	155	54	73.9	4,544
April	203	46	89.9	5,349
May	87	27	47.2	2,902
June	30	21	27.8	1,654
July	21	13	16.7	1,027
August	19	15	17.1	1,051
September	19	15	15.4	916
October	21	15	15.7	965
November	42	13	21.4	1,273
December	36	13	21.6	1,328
The year	203	13	35.6	25,710

NOTE.—Ice is known to form at this station during the winter months, but the observer failed to note the length of time that ice conditions existed during 1905. The open-channel rating table was applied to the winter months without correction.

BRIDGE CREEK NEAR SILVER LAKE, OREG.

Bridge Creek rises in western Lake County, Oreg., and flows northeastward into Silver Creek near the town of Silver Lake.

The gaging station was established January 21, 1905. It is located at the county bridge 2 miles east of Silver Lake, Oreg.

The channel is straight for 50 feet above and 80 feet below the station. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of sand, is free from vegetation, and is permanent. There is but one channel at all stages. The current is swift.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the west end of the bridge, downstream side, and is marked by a 10-penny nail and black paint.

A vertical staff gage, which was read once each day during 1905 by M. S. Henderson and W. D. Robinett, is driven 2 feet into the bed of the stream and spiked to projecting timbers in the center of the bridge on the downstream side. The bench mark is a copper bolt cemented in a large bowlder on the east side of the stream just above the bridge; elevation, 9.73 feet above zero of gage.

Discharge measurements of Bridge Creek near Silver Lake, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 24	I. Landes	7	3.2	1.23	2.05	4.0
February 22	do	7	2.6	1.04	2.05	2.7
March 17 [a]	do	7.5	2.8	1.00	2.00	2.8
May 31 [b]	do	22	12.4	1.12	2.72	13.9
June 15	do	22	13.2	1.14	2.79	15.0
November 11	do	3	.7	1.14	2.05	.8

[a] Measurement made 30 feet below bridge.
[b] Measurement made from bridge.

Daily gage height, in feet, of Bridge Creek near Silver Lake, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.95	1.9	1.95	2.4	2.7	2.2	.....	2.03	2.03	2.03	2.1
2	.....	2.0	1.9	1.95	2.45	2.7	2.2	.....	2.03	2.03	2.02	2.1
3	.....	2.0	1.9	2.0	2.4	2.7	2.2	.....	2.02	2.04	2.03	1.9
4	.....	2.0	1.9	2.0	2.4	2.7	2.15	.....	2.02	2.05	2.03	1.9
5	.....	1.95	1.95	1.8	2.4	2.7	2.1	.....	2.01	2.06	2.02	1.9
6	.....	1.95	1.95	1.8	2.4	2.7	2.0	.....	2.02	2.06	2.03	1.9
7	.....	1.95	1.95	1.85	2.2	2.7	.....	1.94	2.01	2.06	2.03	2.0
8	.....	1.9	1.95	1.85	2.1	2.7	.....	1.93	2.01	2.04	2.03	1.9
9	.....	2.0	1.95	1.85	2.1	2.7	.....	1.94	2.01	2.04	2.03	1.9
10	.....	2.2	1.95	1.9	2.1	2.75	.....	1.92	2.01	2.03	2.03	2.01
11	.....	1.95	1.95	1.9	2.15	2.75	.....	1.9	2.01	2.04	2.03	2.01
12	.....	2.2	1.95	1.95	2.1	2.8	.....	1.9	2.01	2.03	2.03	2.01
13	.....	2.2	1.95	1.95	2.1	2.8	.....	1.92	2.01	2.04	2.03	2.1
14	.....	2.2	2.0	1.95	2.1	2.8	.....	1.92	2.02	2.04	2.03	2.1
15	.....	2.2	2.0	2.0	2.4	2.75	.....	1.9	2.02	2.03	2.02	2.1
16	.....	2.4	2.0	2.0	2.4	2.7	.....	1.92	2.01	2.03	2.03	2.1
17	.....	2.4	2.0	2.0	2.65	2.7	.....	1.95	2.01	2.02	2.03	2.3
18	.....	2.4	2.0	2.0	2.65	2.7	.....	1.98	2.01	2.02	2.03	2.3
19	.....	2.4	2.0	2.0	2.65	2.6	.....	1.96	2.02	2.02	2.1	2.3
20	.....	.....	2.0	1.95	2.65	2.55	.....	1.98	2.02	2.02	2.1	2.3
21	2.3	.....	2.0	1.95	2.65	2.5	.....	1.98	2.02	2.02	2.1	2.4
22	2.3	.....	2.0	1.95	2.65	2.5	.....	2.00	2.01	2.01	2.1	2.4
23	2.15	.....	2.0	1.95	2.6	2.4	.....	1.99	2.01	2.01	2.11	2.4
24	2.2	2.0	2.0	1.95	2.6	2.4	.....	1.98	2.02	2.02	2.11	2.5
25	2.1	1.95	2.0	1.95	2.55	2.35	.....	2.0	2.03	2.02	2.11	2.5
26	2.05	2.0	2.0	2.3	2.6	2.3	.....	2.0	2.03	2.02	2.1	2.5
27	2.0	1.9	2.0	2.4	2.65	2.3	.....	2.04	2.03	2.01	2.1	2.6
28	2.1	1.9	2.0	2.3	2.65	2.25	.....	2.03	2.02	2.01	2.1	2.6
29	2.0	.....	1.9	2.3	2.7	2.2	.....	2.03	2.03	2.02	2.09	2.6
30	1.95	.....	1.95	2.4	2.7	2.2	.....	2.04	2.03	2.03	2.09	2.6
31	1.95	.....	1.95	.....	2.7	.....	.....	2.04	.....	2.03	.....	2.6

NOTE.—Increase in gage heights April 26 to December 31 caused by backwater from a dam. Ice conditions December 17-31.

Station rating table for Bridge Creek near Silver Lake, Oreg., from January 1 to April 25, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	0.8	2.00	2.8	2.20	6.3	2.40	10.0
1.90	1.2	2.10	4.5	2.30	8.1		

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge made during 1905.

Station rating table for Bridge Creek near Silver Lake, Oreg., from April 26 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	0.2	2.20	3.0	2.50	8.6	2.80	15.2
2.00	.6	2.30	4.7	2.60	10.7	3.00	20.0
2.10	1.3	2.40	6.6	2.70	12.9		

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905.

Estimated monthly discharge of Bridge Creek near Silver Lake, Oreg., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January 21-31	8.1	2.0	4.55	99
February 1-19, 24-28	10.0	1.2	4.33	206
March	2.8	1.2	2.23	137
April	6.6	.8	2.53	151
May	12.9	1.3	7.79	479
June	15.2	3.0	10.6	631
July 1-6	3.0	.6	2.18	26
August 7-31	.8	.2	.46	23
September	.7	.6	.66	39
October	.9	.6	.73	45
November	1.5	.7	.95	57
December [a]	1.3	.2	1.00	61
The period				1,954

[a] Ice conditions December 17-31; discharge estimated, 1.3 second-feet.

BEAR CREEK NEAR SILVER LAKE, OREG.

Bear Creek rises in western Lake County, Oreg., and flows northeastward into the western side of Pauline Lake and Marsh.

The gaging station was established January 21, 1905. It is located at the county bridge 3 miles northeast of Silver Lake, Oreg.

The channel is straight for 60 feet above and 25 feet below the station. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of sand, is free from vegetation, and is shifting. There is but one channel, broken at high water by the two piers of the bridge. The current is moderate.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is a 10-penny nail and paint mark at the west end of the bridge, upstream side.

The gage, which was read once each day during 1905 by Cliff Smith, is an inclined staff set on the right bank about 6 feet above the bridge. The bench mark is a copper bolt cemented in the solid rock 80 feet upstream from the bridge and 160 feet west of the west end of the bridge; elevation, 27.04 feet above the zero of the gage.

Discharge measurements of Bear Creek near Silver Lake, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 24	I. Landes	7	4.6	3.14	4.15	14.4
February 23 [a]	do	11	7.4	3.19	4.60	23.6
March 17 [b]	do	8	5.1	2.31	4.0	11.7
May 31 [c]	do	27	37.0	1.36	5.48	50.0
June 15	do	28	25.0	1.88	5.25	46.0
August 7 [d]	do	11	8.7	.72	3.90	6.3
October 4	do	10	7.0	.72	3.85	5.0
October 24	do	10	6.1	1.05	3.92	6.4
November 11	do	9	6.4	1.06	4.03	6.8

[a] 500 feet below bridge. [b] 400 feet below bridge. [c] 100 feet above bridge. [d] 300 feet below bridge.

Daily gage height, in feet, of Bear Creek near Silver Lake, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.1	3.95	4.1	5.0	5.45	5.05	3.9	3.8	3.85	3.9	3.9
2		4.1	4.35	4.0	4.95	5.4	5.0	3.9	3.8	3.85	3.9	3.9
3		4.1	4.55	3.95	4.9	5.45	4.95	3.85	3.8	3.85	3.9	3.9
4		4.1	4.0	3.95	4.9	5.45	4.95	3.85	3.8	3.85	3.9	3.9
5		4.1	4.0	3.95	4.9	5.35	4.9	3.8	3.8	3.85	3.6	3.9
6		4.1	3.95	4.0	4.95	5.25	4.9	3.9	3.8	3.85	3.6	3.9
7		4.1	3.95	4.0	4.95	5.2	4.9	3.9	3.8	3.95	3.8	3.9
8		4.1	3.95	4.0	5.05	5.4	4.85	3.9	3.8	3.95	3.95	3.9
9		4.1	3.95	4.0	5.05	5.4	4.8	3.85	3.8	3.95	4.1	3.9
10		4.1	3.95	4.0	5.0	5.4	4.8	3.85	3.8	3.9	4.1	3.7
11		4.1	3.95	4.0	4.95	5.45	4.8	3.8	3.8	3.9	4.1	3.65
12		4.1	3.95	4.0	5.0	5.45	4.75	3.8	3.8	3.9	4.0	3.65
13		4.1	4.0	4.0	4.95	5.4	4.75	3.8	3.8	3.9	4.0	3.7
14		4.1	4.0	4.85	4.95	5.35	4.8	3.8	3.8	3.9	3.9	3.85
15		4.1	3.95	4.85	5.05	5.3	4.8	3.8	3.8	3.9	3.9	3.9
16		4.1	4.0	4.85	5.25	5.2	4.8	3.85	3.8	3.9	3.9	3.95
17		4.55	4.0	4.85	5.05	5.05	4.8	3.85	3.8	3.9	3.9	3.95
18		4.55	4.0	4.8	5.15	5.05	4.8	3.85	3.75	3.9	3.85	3.95
19		4.5	4.0	4.8	5.15	5.0	4.8	3.85	3.75	3.9	3.75	4.0
20		4.85	4.0	4.8	5.1	4.95	3.9	3.8	3.75	3.9	3.7	4.0
21	4.2	5.0	4.0	4.8	5.0	5.35	3.9	3.8	3.75	3.9	3.7	4.1
22	4.2	4.8	4.0	4.8	4.95	5.35	3.9	3.8	3.75	3.9	3.6	4.1
23	4.2	4.6	4.05	4.75	4.9	5.3	3.9	3.8	3.75	3.9	3.65	4.0
24	4.4	4.4	3.95	4.8	5.0	5.3	3.9	3.8	3.75	3.9	3.7	3.9
25	4.4	4.4	3.95	4.95	5.1	5.25	3.9	3.8	3.75	3.9	3.7	4.0
26	4.2	4.0	3.95	4.9	5.2	5.2	3.9	3.8	3.75	3.9	3.85	4.6
27	4.2	4.1	3.95	4.9	5.4	5.2	3.9	3.8	3.75	3.9	3.85	4.6
28	4.1	4.0	3.95	4.95	5.4	5.3	3.9	3.8	3.75	3.9	3.9	4.2
29	4.1	.....	3.95	4.75	5.4	5.25	3.9	3.8	3.75	3.9	3.9	4.2
30	4.1	.....	3.85	5.0	5.5	5.05	3.9	3.8	3.75	3.9	3.9	4.2
31	4.1	.....	3.75	.....	5.5	.....	3.9	3.8	.....	3.9	.....	4.2

NOTE.--Increased gage heights April 14 to July 19 caused by back water from dam. Dam removed July 20. Ice conditions last half of December.

SUMMER LAKE BASIN.

ANA RIVER NEAR SUMMER LAKE, OREG.

Ana River, which discharges into the north end of Summer Lake, has its source in five large springs of almost constant flow and temperature throughout the year. The river is about 5 miles long.

The gaging station was established March 28, 1905. It is located in the NW. ¼ SE. ¼ sec. 6, T. 30 S., R. 17 E., near Summer Lake, Oreg.

The channel is straight for 50 feet above and below the station. Both banks are clear and do not overflow. The bed of the stream is composed of blue clay and is fairly permanent. There is but one channel at all stages. The current is swift. Gage readings may be affected somewhat by backwater from the lake and a temporary irrigation dam.

Discharge measurements are made from a foot log near the gage. The initial point for soundings is the edge of the water on the right bank of the river, and is marked on the foot log.

A vertical staff gage, on which, during 1905, observations were made at irregular intervals by the hydrographer, is set at the right bank of the river. The bench mark is a 60-penny nail in the base of a large yellow pine a short distance above the gage; elevation above zero of gage, 11.84 feet.

Discharge measurements of Ana River near Summer Lake, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 28	I. Landes	27	54	2.72	3.50	148
April 6	do	27	54	2.73	3.50	149
June 8	do	27	61	2.41	[a] 3.68	148

[a] Gage height affected by irrigation dam.

ALBERT LAKE BASIN.

CHEWAUCAN RIVER AT PAISLEY, OREG.

Chewaucan River rises in south-central Lake County, Oreg., flows northwest, then northeast, and then southeast, and discharges into the south end of Abert Lake. The changes in course are very abrupt.

The gaging station was established January 4, 1905. It is located one-half mile above Paisley, Oreg.

The channel below the station is straight; above the station it is slightly curved for 75 feet and beyond this point there are rapids. The right bank is low, but it overflows only a little, there being no water beyond the cable except in very unusual floods. The left bank is high, is composed of clean gravel, and does not overflow. The bed of the stream is of gravel, is free from vegetation, and is permanent. There is but one channel at all stages. There is a low dam 250 feet below the cable, but it does not back the water up at the gage.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire, 60 feet below the gage. The initial point for soundings is the zero of the tagged wire, 7.1 feet from the clip to which the wire is attached at the left bank.

The gage, which was read once each day during 1905 by George Reed and Miss Lulu Banister, is a vertical rod attached to a tree on the right bank. The bench mark is a 60-penny spike in a notch in the base of a large cottonwood tree on the right bank, 22.5 feet upstream from the cable: elevation, 7.69 feet above zero of gage.

Discharge measurements of Chewaucan River at Paisley, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
January 5[a]	I. Landes	35	64	.80	4.15	51
February 26	do	34	69	1.48	4.20	102
March 22	do	36	75	1.79	4.45	135
April 5	do	37	86	2.14	4.65	183
May 11	do	39	93	2.28	4.72	213
June 4	do	40	111	2.77	5.12	308
July 4	do	32	50	.85	3.80	42
July 26	do	32	37	.61	3.57	23
September 28	do	32	47	.89	3.67	41
November 3	do	32	42	.69	3.57	29
November 22	do	32	54	.78	3.72	42

[a] Slush ice running in river.

Daily gage height, in feet, of Chewaucan River at Paisley, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.3	4.2	4.4	5.0	4.8	4.0	3.5	3.4	3.6	3.5	3.6
2	.....	4.1	4.3	4.5	4.95	4.75	3.9	3.5	3.4	3.6	3.5	3.7
3	.....	4.0	4.25	4.5	4.85	4.8	3.82	3.4	3.4	3.6	3.6	3.7
4	4.0	4.0	4.25	4.5	4.8	5.15	3.75	3.4	3.4	3.6	3.5	3.7
5	4.15	4.0	4.3	4.65	4.85	5.0	3.7	3.4	3.5	3.6	3.5	3.5
6	4.2	3.85	4.3	4.8	4.8	4.8	3.7	3.4	3.5	3.6	3.6	3.6
7	4.2	3.6	4.35	4.9	4.8	4.7	3.7	3.4	3.5	3.7	3.6	3.6
8	4.1	3.8	4.3	4.9	4.9	4.8	3.7	3.4	3.5	3.7	3.6	3.8
9	4.1	3.6	4.3	4.9	4.85	4.8	3.6	3.4	3.5	3.6	3.6	4.0
10	5.0	3.6	4.35	4.8	4.7	4.7	3.6	3.4	3.5	3.6	3.6	4.2
11	5.15	3.5	4.4	4.75	4.7	4.6	3.6	3.4	3.5	3.6	3.5	4.1
12	5.2	4.1	4.5	4.8	4.8	4.7	3.6	3.4	3.5	3.6	3.5	4.1
13	4.9	4.2	4.65	4.9	4.75	4.6	3.6	3.4	3.5	3.6	3.6	4.0
14	5.2	4.0	4.6	4.7	4.75	4.6	3.6	3.4	3.5	3.6	3.7	4.0
15	4.5	4.05	4.5	4.8	4.85	4.5	3.6	3.4	3.5	3.6	3.6	4.0
16	4.4	3.9	4.6	4.8	4.95	4.5	3.6	3.4	3.5	3.6	3.7	3.9
17	4.3	3.9	4.65	4.7	5.05	4.4	3.6	3.4	3.5	3.6	3.7	3.8
18	4.1	3.9	4.6	4.75	5.0	4.3	3.6	3.4	3.5	3.6	3.7	3.8
19	4.05	4.05	4.6	4.7	5.0	4.3	3.6	3.4	3.5	3.5	3.7	3.7
20	4.0	4.25	4.5	4.7	4.95	4.3	3.7	3.4	3.5	3.5	3.6	3.8
21	3.95	4.1	4.55	4.75	4.85	4.2	3.7	3.4	3.5	3.5	3.6	4.2
22	3.9	3.95	4.45	4.8	4.85	4.2	3.7	3.4	3.5	3.5	3.6	4.5
23	4.5	4.0	4.45	4.9	4.85	4.2	3.6	3.4	3.5	3.5	3.7	4.6
24	4.4	4.1	4.4	5.0	4.8	4.2	3.6	3.4	3.5	3.6	3.6	4.8
25	4.2	4.1	4.35	5.05	4.7	4.2	3.6	3.4	3.5	3.6	3.6	4.6
26	4.0	4.1	4.8	5.15	4.9	4.2	3.7	3.4	3.5	3.6	3.7	4.0
27	4.2	4.1	4.45	5.1	5.0	4.1	3.6	3.4	3.6	3.6	3.6	4.0
28	3.9	4.15	4.4	5.1	4.9	4.0	3.6	3.5	3.7	3.6	3.7	4.0
29	4.0	.....	4.3	5.1	4.8	4.0	3.6	3.5	3.6	3.6	3.6	4.0
30	4.1	.....	4.0	5.15	4.8	3.9	3.5	3.4	3.6	3.6	3.6	4.0
31	4.5	.....	4.15	.....	4.8	.....	3.5	3.4	.....	3.6	.....	4.1

NOTE.—Ice gorge January 10-13.

Station rating table for Chewaucan River at Paisley, Oreg., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
		3.80	43	4.30	111	4.80	223
3.40	19	3.90	53	4.40	131	4.90	249
3.50	23	4.00	64	4.50	152	5.00	276
3.60	29	4.10	77	4.60	174	5.10	304
3.70	36	4.20	93	4.70	198		

NOTE.—The above table is applicable only for open channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 3.55 feet and 5.25 feet.

Estimated monthly discharge of Chewaucan River at Paisley, Oreg., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	332	53	94.1	5,786
February	111	23	64.6	3,588
March	223	64	136	8,362
April	318	131	230	13,600
May	290	198	238	14,630
June	318	53	154	9,164
July	64	23	33.2	2,041
August	23	19	19.5	1,199
September	36	19	23.5	1,398
October	36	23	28.5	1,752
November	36	23	29.7	1,767
December	223	23	70.8	4,353
The year	332	19	93.5	67,730

NOTE.—Ice gorge January 10-31; discharge assumed 77 second-feet. Ice conditions for the remainder of the winter months not known; open-channel rating table applied.

MISCELLANEOUS MEASUREMENTS IN GREAT BASIN.

The following miscellaneous measurements were made in the Great Basin in 1905 by W. G. Swendsen, H. S. Kleinschmidt, W. P. Hardesty, A. B. Larson, and I. Landes:

Miscellaneous measurements in Great Basin, 1905.

Date.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
			Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
March 21	Logan River	Logan, Hyde Park and Smithfield Canal, near Logan, Utah.	10	5.6	0.83	3.85	4.7
March 8	Jordan River	Near Lehi, Utah	49	20	.83	.50	17
January 28	Hobble Creek	Springville, Utah, near mouth of creek.	23	13.6	1.40	.....	19
February 15	do	do	16	9.8	1.52	.....	15
March 9	do	do	8	8.6	.83	.....	6.5
April 3	Peteetneet Creek.	At mouth of canyon near Payson, Utah.	10	.....	.....	.....	[a] 20.6
May 6	do	do	10	.....	.....	.....	[a] 11.4
August 31	do	do	3.45	3.86	.92	.....	3.55
May 3	Summit Creek	Near Santaquin, Utah.	11	7.3	2.95	.....	21.5
May 12	do	do	6	3.1	4.81	.55	15
June 10	do	do	6	6.5	3.71	1.08	24
August 31	do	do	6	4.3	1.61	.72	7
July 21	Silver Creek	At Spencer's, Riley, Oreg.	4	1.33	1.13	.....	1.5
January 8	Ana River	County Bridge, Summerlake, Oreg.	32	107	1.40	.....	150
May 11	George Conn's ditch.	Paisley, Oreg	7	3.5	1.93	.....	6.7
July 4	do	do	7	5.2	2.78	.....	14.6

[a] Weir measurement.

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 176.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888-1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Union Trust Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Huntley, Mont.; Hazen, Nev.; Boise, Idaho; North Yakima, Wash.; Portland, Oreg., 351 Washington street.

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THE DIRECTOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

JUNE, 1906.

O

Water-Supply and Irrigation Paper No. 177 Series P, Hydrographic Progress Reports, 58

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART XIII.—Great Basin and Pacific Ocean Drainages in California, and Colorado River Drainage below Gila River

BY

W. B. CLAPP and J. C. HOYT

WASHINGTON
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PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

PART XIII.

By W. B. Clapp and J. C. Hoyt.

INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semi-arid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriation for hydrographic surveys, fiscal years ending June 30, 1895 to 1906.

1895	$12,500	1901	$100,000
1896	20,000	1902	100,000
1897	50,000	1903	200,000
1898	50,000	1904	200,000
1899	50,000	1905	200,000
1900	50,000	1906	200,000

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning

the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi River drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

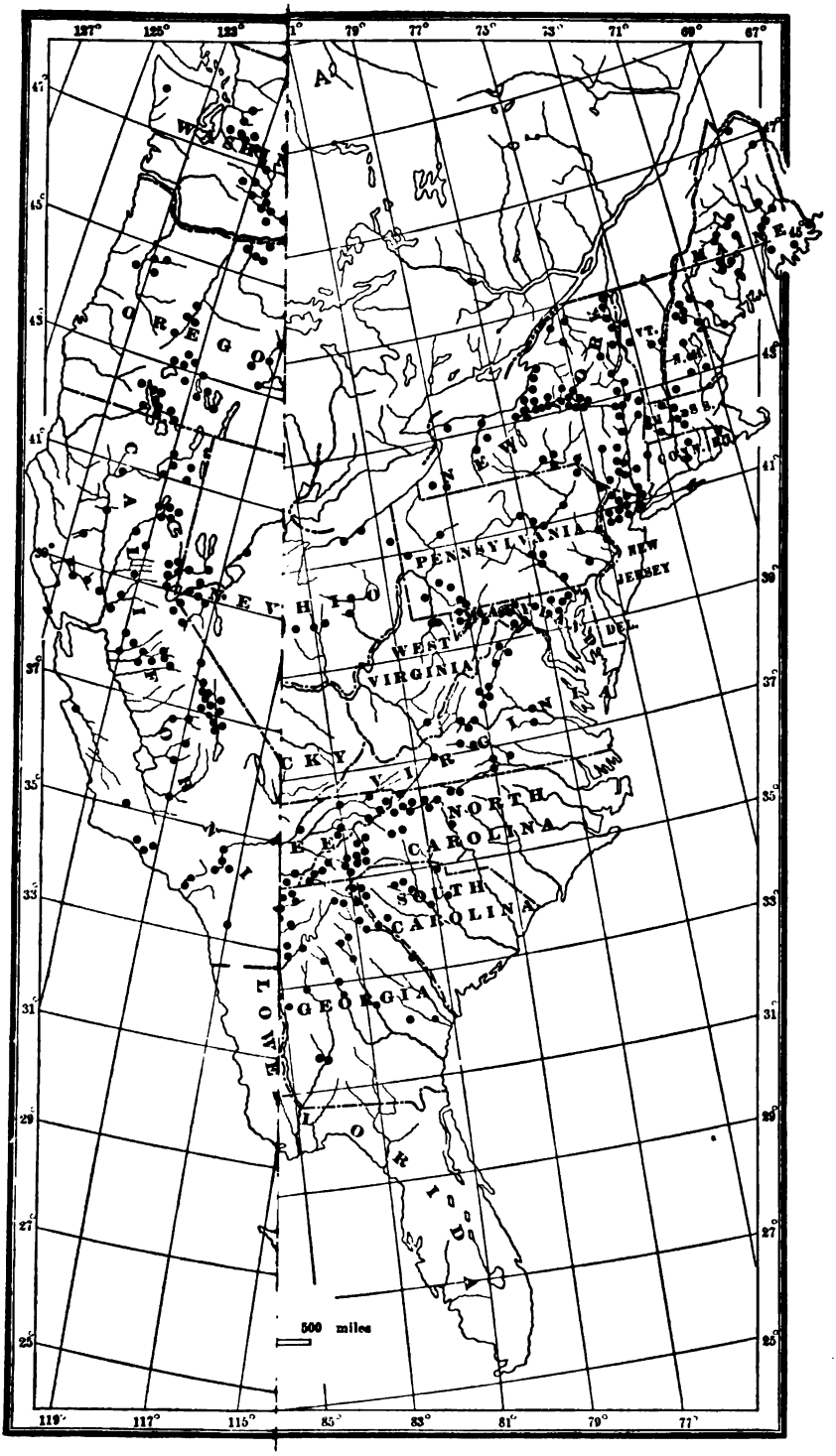
List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.	Thames.
St. Croix.	Housatonic.
Penobscot.	Hudson.
Kennebec.	Passaic.
Androscoggin.	Raritan.
Presumpscot.	Delaware.
Saco.	Susquehanna.
Merrimac.	Potomac.
Connecticut.	Minor Chesapeake Bay.
Blackstone.	Minor Northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor Southern Atlantic.


127°
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81°
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73°
71°
69°
67°
45°
43°
41°
39°
37°
35°
33°
31°
29°
27°
25°
119°
117°
115°
85°
83°
81°
79°
77°
OREGON
PENNSYLVANIA
NEW JERSEY
WEST VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
500 miles

DURING 1905.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor Eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadalupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor Western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharges," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the area of cross section, the mean velocity, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5 and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5 and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

Special rules for computation.

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.
2. Daily discharges shall be applied directly to the gage heights as they are tabulated.
3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.
4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.

1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1½ horsepowers equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$=Net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; l=length of weir in inches; h=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1 : 125000, 1 mile=0.50688 inch.
Scale 1 : 90000, 1 mile=0.70400 inch.
Scale 1 : 62500, 1 mile=1.01376 inches.
Scale 1 : 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{R\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=cbh^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash-boards or exceptional care in reducing leaking through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings the heads under which they work, and their angular velocities may be accurately abserved.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient be used in the weir formula, and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practicaliy the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semi-permanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation it made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

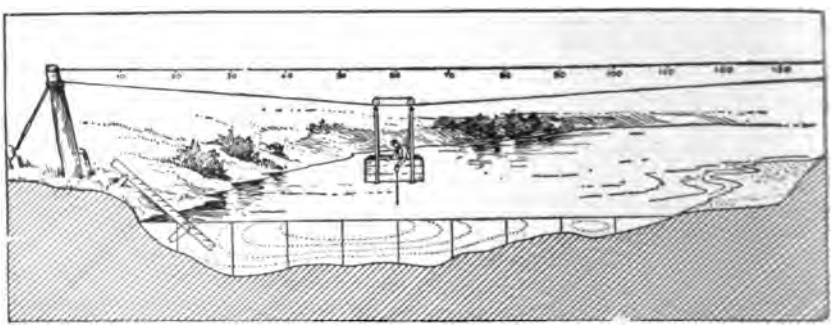

FIG. 1.—Cable station showing section of the river, car, gage, etc.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and conditions of the stream. Perpendiculars

dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison, and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either

by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make freqeunt discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, the varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 14[illegible], pages 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates; and discharge, mean velocity, and area as abscissas will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the hortzontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each

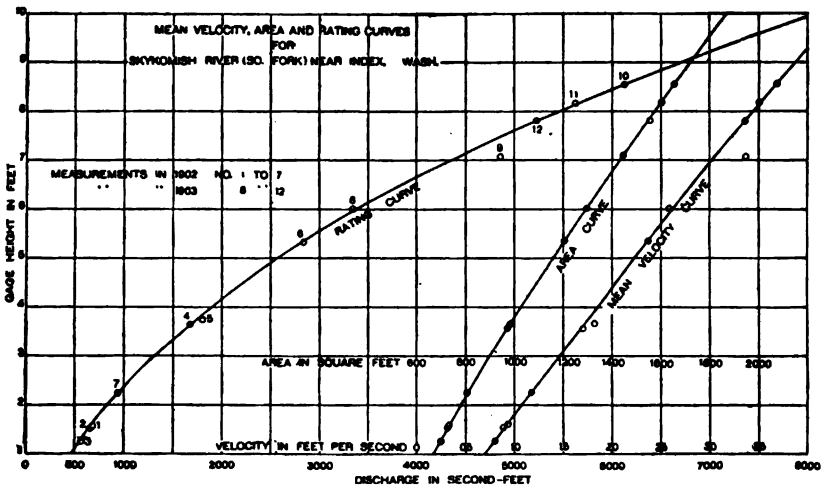

FIG. 2.—Discharge mean-velocity and area curves for South Fork of Skykomish River near Index.

measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall be either constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly, or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by

gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is due to each of these persons, and thanks are extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The hydrographic work of the United States Geological Survey in California is being carried on in cooperation with the State, in accordance with acts of the State legislature approved March 16, 1903, and March 20, 1905.

The act of March 16, 1903, which covered the period from July 1, 1903, to June 30, 1905, is in substance as follows:

> The State board of examiners are hereby empowered to enter into contracts with the Director of the United States Geological Survey for the purpose of making topographic maps to the extent of twenty thousand dollars; also for the purpose of gaging streams, surveying reservoir sites and canal locations, for the conservation and utilization of the flood or storm waters of the State, to the extent of fifteen thousand dollars, [etc.]

The act of March 20, 1905, is in substance the same as previous act, the appropriations being increased to $30,000 for topography and $20,000 for hydrography, and covering the two fiscal years July 1, 1905, to June 30, 1907.

The State board of examiners is composed of the following members: George C. Pardee, governor; C. F. Curry, secretary of state; U. S. Webb, attorney-general.

Although the portions of these bills referring to hydrographic work provide for making surveys of reservoir sites and canal locations, none of the State money has been expended for this purpose. The Geological Survey has made these investigations on Puta Creek, Cache Creek, Sacramento River, Pit River and tributaries, Feather River and tributaries, Owens River, and Colorado River, and has paid the entire expense from its own funds.

The State appropriation of $15,000, which was available between July 1, 1903, and June 30, 1905, was used exclusively for gathering general stream-flow data. The Survey also apportioned $20,000 for the same purpose during the same period. The data being accumulated have a specific value in connection with the future development of the resources of the State. The information will be invaluable in designing and making estimates of cost for storage, irrigation, power and drainage works, and for use in litigation.

The work in California is under the direction of Supervising Engineer J. B. Lippincott,[a] assisted by Engineer W. B. Clapp, who has immediate charge of the accumulation of hydrographic data. Acknowledgments are also due to the following individuals and corporations for assistance rendered and data furnished: To J. C. Pierson, city surveyor of Sacramento, Cal., for river-stage and turbidity records of Sacramento River at Sacramento; to the Kern County Land Company, through A. K. Warren, engineer in charge of water measurements, for the record of Kern River; to the city of Santa Barbara for cooperation in gaging Santa Ynez River; to the Bay Cities Water Company, through Edwin Duryea, jr., chief engineer, for precipitation and run-off data; to the Southern Pacific Company, through its chief engineer, William Hood, for river-stage records of San Joaquin River at Herndon, Cal., and for transportation furnished the supervising engineer and assistants; and to the officials of the Santa Fe Railway for transportation furnished to the supervising engineer and assistants.

The work in the extreme eastern portion of California was carried on under the direction of Henry Thurtell,[b] State engineer of Nevada, assisted by W. A. Wolf, J. T. Shaw, R. A. Craig, O. F. Heizer, and L. A. Wooley. Acknowledgment is due to the Southern Pacific Company for transportation furnished the district hydrographers and assistants.

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[a] Office, 1108 Union Trust Building, Los Angeles, Cal. [b] Office, Carson, Nev.

COLORADO RIVER DRAINAGE BASIN BELOW GILA RIVER.

COLORADO RIVER AT YUMA, ARIZ.

This station is located in the town of Yuma, Ariz., 1½ miles below the mouth of Gila River and 10 miles, by river, above the Mexican boundary. Records of river height have been kept by the Southern Pacific Company since April 1, 1878, on the gage which was established by Arthur Brown, superintendent of the company's bridge and building department, during the summer of 1876.

The channel of the main river is straight for 600 feet above and 5,000 feet below the station. The right bank is low, wooded, and liable to overflow; the left bank is not subject to overflow. The bed of the stream is composed of silt and sand and is very unstable. At low water the channel has a width of 300 feet; at flood stages a large part of the water flows through an old channel and does not pass under the cable. The current is swift and the gaging section regular. At all stages of the river the depth and the velocity are uniform and there are no large eddies.

Prior to May 31, 1903, discharge measurements were made from the railroad bridge. On that date a cable station was established at a point 600 feet below the bridge, and all measurements are now made from a car, except during highest floods, when a boat is used. The cable is supported on masts and is equipped with a winch, by which it can be lowered for the passage of boats. The cable has a span of 650 feet. The initial point for soundings is the cable support on the south or left bank about 20 feet from the water's edge at high water. The water that flows in the old channel at flood stages is measured at the point where it passes under the railway trestle, one-third mile north of the main channel. During the flood of May and June, 1905, there were two breaks in the railroad grade at Araz, Cal., 4 miles from Yuma, and the water passing through these is included in each discharge measurement of the Colorado.

The gage, which was read twice each day during 1905 by W. D. Smith, the resident hydrographer, is in two sections. The lower section of the rod, reading from 15 to 25 feet, is nailed to the pile protection on the south bank of the river 50 feet below the Southern Pacific Railroad bridge. The upper section, reading above 24 feet, is a long pile on the north bank of the river 100 feet above the railway bridge, and is the original gage established in 1876. The bench mark is a standard United States Geological Survey bronze cap located at the railway bridge on the first pier from the south bank; elevation, 35.31 feet above the zero of the gage and 137.4 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water Supply Paper):

Description: Ann 18, iv, pp 298–299; Bull 131, p 51; 140, pp 207–208; WS 16, p 151; 28, p 133; 38, p 324; 50, p 387; 66, p 104; 85, p 17; 100, pp 19–20; 133, pp 25–26.
Discharge: Ann 18, iv, p 299; Bull 131, p 51; 140, p 208; 66, p 104; 85, p 18; 100, pp 20–24; 133, pp 26–29.
Discharge, mean daily: WS 133, p 31.
Discharge, monthly: WS 85, p 20; 100, p 25; 133, p 32.
Evaporation record: WS 133, p 32.
Gage heights: Bull 131, p 52; 140, pp 208–210; WS 11, p 73; 16, p 151; 28, p 141; 38, p 325; 50, p 387; 66, p. 104; 85, p 19; 100, pp 24–25; 133, p 30.
Hydrograph: Ann 12, ii, p 290.
Rating table: WS 85, p 19.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the area of cross section, the mean velocity, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

Discharge measurements of Colorado River at Yuma, Ariz., in 1905—Continued.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
September 13.	W. D. Smith.....	18.85	7,706	November 3..	W. D. Smith.....	18.50	5,812
September 14.	.....do.....	19.40	9,667	November 6..	.....do.....	18.35	5,709
September 16.	.....do.....	18.80	7,700	November 9..	.....do.....	18.75	6,632
September 18.	.....do.....	18.60	6,743	November 13.	.....do.....	18.75	6,308
September 20.	.....do.....	18.70	7,131	November 16.	.....do.....	18.85	6,787
September 23.	.....do.....	18.45	6,063	November 23.	.....do.....	18.80	6,495
September 26.	.....do.....	18.20	5,260	November 27.	.....do.....	19.00	6,652
September 29.	.....do.....	18.00	5,287	November 30.	.....do.....	31.30	102,700
October 2.....	.....do.....	18.00	5,222	December 1...	.....do.....	28.78	77,360
October 4.....	.....do.....	18.65	7,172	December 2...	.....do.....	23.50	37,160
October 6.....	.....do.....	18.80	7,295	December 5...	.....do.....	21.30	28,650
October 7.....	.....do.....	20.10	13,080	December 8...	.....do.....	19.50	16,970
October 10....	.....do.....	20.30	14,060	December 11..	.....do.....	18.75	12,620
October 13....	.....do.....	19.70	10,660	December 14..	.....do.....	18.30	9,613
October 16....	.....do.....	19.10	8,290	December 16..	.....do.....	18.20	8,795
October 19....	.....do.....	18.70	6,779	December 18..	.....do.....	17.95	7,807
October 23....	.....do.....	18.60	6,025	December 21..	.....do.....	17.85	7,670
October 27....	.....do.....	18.40	5,507	December 26..	.....do.....	17.95	7,502
October 31....	.....do.....	18.40	5,579	December 30..	.....do.....	17.80	5,981

Daily gage height, in feet, of Colorado River at Yuma, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.....	18.5	19.45	23.9	21.5	25.0	27.55	26.8	19.95	18.5	18.0	18.4	28.05
2.....	18.5	19.6	25.05	21.4	24.7	27.8	26.5	19.9	18.4	18.0	18.45	24.05
3.....	18.5	19.7	26.7	21.3	24.7	28.0	25.9	19.85	18.4	18.3	18.5	23.95
4.....	18.6	19.7	26.7	21.3	24.25	28.2	25.45	19.8	18.45	18.8	18.4	22.9
5.....	18.75	20.3	25.3	21.65	24.25	28 35	25.45	19.8	18.4	19.0	18.35	21.3
6.....	18.95	21.2	24.8	22.6	24.55	28.45	25.0	19.9	18.3	18.95	18.35	20.5
7.....	19.0	21.05	24.8	22.5	24.7	28.55	24.6	20.3	18.2	20.05	18.4	20.0
8.....	18.9	27.2	24.7	22.1	25.1	28.3	24.1	20.5	18.3	20.2	18.65	19.5
9.....	18.65	28.75	24.1	22.0	25.75	28.2	23.8	20.3	18.45	20.6	18.75	19.2
10.....	21.0	26.6	23.9	22.0	26.1	28.15	23.35	20.2	18.95	20.3	18.8	18.95
11.....	19.25	24.1	24.1	21.85	26.3	28.2	22.8	20.45	18.7	20.1	18.8	18.75
12.....	19.2	22.95	24.75	22.10	26.1	28.25	22.6	20.4	18.6	19.95	19.0	18.45
13.....	19.25	22.4	24.35	25.45	25.5	28.4	22.1	20.15	18.85	19.7	18.75	18.4
14.....	19.45	22.2	23.7	29.25	25.1	28.7	22.0	20.1	19.45	19.3	18.65	18.3
15.....	19.65	22.25	24.35	29.65	25.0	28.7	21.9	19.75	19.2	19.2	18.75	18.2
16.....	19.75	21.6	26.35	27.2	25.05	28.75	21.95	19.6	18.8	19.1	18.85	18.2
17.....	22.2	21.1	27.35	24.9	24.95	28.85	22.25	19.35	18.65	18.9	18.85	18.0
18.....	23.8	21.4	26.55	24.55	24.7	28.95	21.7	19.15	18.6	18.75	18.8	17.95
19.....	22.2	22.65	28.1	24.9	24.5	29.15	21.3	19.05	18.6	18.7	18.95	17.9
20.....	21.0	24.9	30.3	24.4	24.3	29.05	21.25	19.0	18.7	18.7	18.9	17.95
21.....	20.45	25.75	29.75	23.3	24.45	29.10	20.95	18.85	18.6	18.65	18.8	17.8
22.....	20.55	25.85	28.9	22.8	24.65	29.1	20.7	18.8	18.45	18.6	18.8	17.85
23.....	20.3	23.55	27.75	22.6	24.85	29.0	20.5	18.75	18.45	18.6	18.8	17.85
24.....	20.0	22.0	25.6	22.35	25.25	28.85	20.5	18.7	18.4	18.6	18.7	17.9
25.....	19.8	21.45	24.1	22.6	25.55	28.75	20.45	18.65	18.35	18.6	18.75	17.85
26.....	19.75	23.65	23.4	23.45	25.75	28.55	20.35	18.65	18.2	18.5	18.8	17.95
27.....	19.65	23.5	23.1	23.95	26.0	28.25	20.2	18.7	18.0	18.4	19.05	17.9
28.....	18.55	23.5	22.85	24.15	26.4	27.9	20.05	18.7	18.0	18.35	21.3	17.8
29.....	19.4	.....	22.4	23.95	26.8	27.6	19.95	18.65	18.0	18.4	26.2	17.8
30.....	19.35	.....	22.0	24.55	27.0	27.25	20.0	19.5	18.0	18.45	31.3	17.8
31.....	19.3	.....	21.9	.....	27.4	.....	19.95	18.8	.....	18.4	.....	17.8

Daily discharge, in second-feet, of Colorado River at Yuma, Ariz., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,750	5,800	29,070	20,690	41,520	61,500	57,800	16,400	6,440	5,240	5,620	77,360
2	3,750	6,054	39,260	20,100	39,700	65,300	55,500	15,790	6,280	5,220	5,720	37,160
3	3,800	6,500	70,170	19,480	39,700	68,160	50,640	14,700	6,250	6,140	5,810	40,200
4	3,985	6,632	70,200	19,450	37,280	67,900	45,000	13,560	6,464	7,170	5,750	35,000
5	4,300	9,800	51,100	21,000	37,100	67,600	44,950	12,900	6,160	8,250	5,700	28,650
6	4,570	16,590	44,310	30,100	37,410	67,600	42,400	14,200	5,644	7,300	5,710	23,300
7	4,700	9,400	44,100	29,840	38,000	69,500	40,100	15,940	5,060	13,080	5,860	20,100
8	4,500	62,080	43,100	25,800	40,050	72,930	37,200	17,450	5,560	13,560	6,360	16,970
9	4,170	82,820	36,400	24,800	46,000	70,300	35,500	16,770	6,051	15,500	6,630	15,000
10	16,090	52,580	34,400	24,900	49,200	69,600	32,980	16,200	8,000	14,060	6,680	13,700
11	6,400	37,320	38,620	23,000	52,000	71,000	32,100	16,960	7,631	12,950	6,550	12,620
12	6,300	29,700	42,000	26,100	48,000	72,590	31,720	16,900	6,900	12,100	6,950	10,500
13	6,350	22,800	38,870	45,800	38,840	76,000	30,870	16,150	7,706	10,660	6,310	10,200
14	7,000	21,900	32,000	93,800	37,800	82,020	29,500	15,960	9,667	9,100	6,050	9,610
15	8,370	22,500	36,720	97,500	37,300	82,000	27,710	14,500	8,900	8,650	6,500	9,100
16	8,600	18,610	60,640	70,100	37,320	83,000	28,300	13,800	7,700	8,290	6,790	8,900
17	20,100	14,600	65,820	45,000	37,000	86,000	31,100	11,900	7,000	7,500	6,640	8,100
18	27,500	16,490	62,400	43,600	33,910	88,500	25,300	10,300	6,743	6,950	6,560	7,810
19	19,300	31,500	73,440	45,050	34,200	94,320	22,320	9,757	6,720	6,780	6,320	7,750
20	12,120	47,000	110,840	43,400	34,580	91,500	22,250	9,350	7,131	6,700	6,240	7,720
21	9,300	54,200	103,500	39,500	35,700	92,400	22,000	8,690	6,700	6,400	6,320	7,670
22	10,170	54,730	91,200	35,900	37,000	92,390	21,500	8,100	6,080	6,100	6,400	7,640
23	7,863	32,990	76,930	33,900	38,390	89,800	20,900	7,796	6,063	6,020	6,500	7,600
24	7,900	21,990	58,600	31,690	41,500	84,800	20,800	7,550	5,890	6,000	6,520	7,560
25	7,025	18,850	43,050	33,000	43,700	82,000	20,650	7,380	5,740	5,970	6,550	7,540
26	6,770	30,500	34,600	37,160	45,290	77,610	20,460	7,241	5,260	5,750	6,580	7,500
27	6,250	27,730	31,020	41,630	47,600	73,500	19,700	7,240	5,270	5,510	6,650	7,300
28	5,730	25,000	29,500	39,000	51,100	68,500	18,910	7,013	5,280	5,400	24,500	6,700
29	5,400	.....	26,900	34,990	54,810	64,370	17,200	6,850	5,287	5,540	62,500	6,400
30	5,070	.....	24,390	38,700	56,300	61,500	17,500	10,290	5,260	5,670	102,700	5,980
31	4,900	.....	23,500	.....	59,020	.....	16,750	7,500	.....	5,580	.....	5,900

NOTE.—Daily discharge obtained by indirect method.

Estimated monthly discharge of Colorado River at Yuma, Ariz., for 1905.

[Drainage area, 225,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	27,500	3,750	8,130	499,900	0.036	0.042
February	82,820	5,800	28,100	1,561,000	.125	.130
March	110,800	23,500	50,540	3,108,000	.225	.259
April	97,500	19,450	37,830	2,251,000	.168	.187
May	59,020	33,910	42,170	2,593,000	.187	.216
June	94,320	61,500	76,470	4,550,000	.340	.379
July	57,800	16,750	30,310	1,864,000	.135	.156
August	17,450	6,850	12,100	744,000	.054	.062
September	9,667	5,060	6,495	386,500	.029	.032
October	15,500	5,220	8,037	494,200	.036	.042
November	102,700	5,620	12,000	714,000	.053	.059
December	77,360	5,900	15,400	946,900	.068	.078
The year	110,800	3,750	27,300	19,710,000	.121	1.64

Yearly maximum and minimum gage heights, in feet, of Colorado River at Yuma, Ariz., 1878 to 1905.

[Compiled from the records of Capt. Isaac Polhamus, the Southern Pacific Railroad, and the United States Geological Survey.]

Year.	Maximum.		Minimum.		Year.	Maximum.		Minimum.	
	Height.	Date.	Height.	Date.		Height.	Date.	Height.	Date.
1878	23.0	June 24	14.7	Dec. 31	1892	25.5	July 3	15.5	Dec. 31
1879	20.0	May 12	13.2	Oct. 14	1893	25.2	May 28	15.5	Jan. 2
1880	24.0	May 31	14.9	Dec. 8	1894	23.7	June 14	15.9	Jan. 23
1881	23.5	June 14	15.0	Jan. 25	1895	28.2	Jan. 20	16.8	Feb. 13
1882	22.6	June 18	15.5	Dec. 20	1896	24.5	Sept. 30	17.4	Dec. 17
1883	24.5	July 3	14.0	Dec. 14	1897	26.1	June 9	17.9	Dec. 21
1884	[a] 28.5	June 27	14.2	Dec. 5	1898	23.6	June 27	17.5	Jan. 8
1885	24.7	June 13	13.7	Feb. 8	1899	27.0	July 1	17.0	Oct. 17
1886	26.8	June 6	14.4	Jan. 19	1900	26.0	June 10	16.4	Sept. 10
1887	23.5	June 10	14.9	Jan. 26	1901	27.2	May 31	16.2	Jan. 14
1888	21.8	June 25	14.8	Jan. 4	1902	24.5	May 26	16.6	Sept. 28
1889	22.4	June 7	15.4	Sept. 27	1903	27.7	June 26	16.8	Jan. 13
1890	25.5	June 5	16.4	Jan. 29	1904	26.3	June 5	18.3	Dec. 27
1891	[b] 33.2	Feb. 26	16.4	Sept. 22	1905	31.3	Nov. 30	17.8	Dec. 31

[a] Said to be highest flood for 17 years preceding. [b] Highest flood recorded.

COLORADO RIVER BELOW HEADING NO. 3 OF THE IMPERIAL CANAL.

Measurements at this point were begun July 12, 1905, as so much water was at that date going down the canal that it was simpler and more economical to measure the water in the old channel of the Colorado than to continue the measurements on the canal itself.

In the center of the river, opposite heading No. 3, is an island nearly a mile long. The channel on the west side of the island is about 600 feet wide; that on the east side is about 800 feet wide. At first the discharge was measured at a point below the island, but by August 15 a sand bar had formed from the island to the west bank of the river below the heading, and all water passing down on the west of the island entered the canal. August 31 a gage was established above the head of the island, and after that date all discharge measurements were made at the head of the island. Measurements were not made at one certain point, but at any favorable cross section among the shifting bars of mud and quicksand that could be reached and measured by boat or by wading.

The old channel continued to silt up gradually and the new one to scour deeper, and October 20, 1905, all the water was carried by the new channel, i. e., the Imperial canal. The California Development Company made a serious and expensive effort to turn the water back by constructing a dam of piles, brush mats, brush, and sand bags. By the latter part of November this dam had progressed sufficiently to raise the height of the water 2.5 feet, and about 300 second-feet of water flowed down the old channel. Most of the great flood of November 29 at its crest went down the old channel; but by the time it had receded the dam was washed away, the old channel was silted up higher than before, and the new channel was scoured still deeper.

The gage is a vertical rod nailed to the root of a large willow stump on the east bank of the river. It is located at a point nearly opposite the upper end of the upper row of piling, extending from the head of the island obliquely upstream to the west bank, and is opposite station 425 of the Yuma Valley levee line. The bench mark is a nail in a willow tree 20 feet above the gage and 25 feet from the bank; elevation, 13.05 feet above the zero of the gage. Levels from the levee line show the elevation of the zero of the gage to be 109.19 feet above sea level.

Discharge measurements of Colorado River, below heading No. 3 of Imperial canal in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 12	W. D. Smith		11,610	October 18	W. D. Smith	1.50	25
July 30	L. B. Brainard		2,484	October 25	do	1.00	[a] 0
August 3	F. R. S. Buttemer		1,999	October 30	do	.95	[a] 0
August 10	do		2,218	November 4	do	.95	[a] 0
August 18	W. D. Smith		1,169	November 11	do		[a] 0
August 24	do		769	November 18	do	2.10	87
August 31	do	2.90	557	November 25	do	2.45	205
September 7	do	1.80	90	November 30	J. A. Tolin		[b] 70,000
September 14	do	3.80	1,232	December 7	W. D. Smith		878
September 22	do	2.10	175	December 13	do		[c] 0
September 28	do	1.60	37	December 17	do		[c] 0
October 11	do	3.50	1,014	December 23	do		[a] 0

[a] No discharge October 20 to November 11. [b] Estimated. [c] No discharge December 13-31.

CANALS BELOW YUMA, ARIZ.

COLORADO VALLEY PUMPING AND IRRIGATION COMPANY'S CANAL AT YUMA, ARIZ.

This canal diverts water from the Colorado River at Yuma, Ariz., for the purpose of irrigating land in the upper part of Yuma Valley. The water is raised by a large centrifugal pump operated by a steam engine of 125 horsepower. The lift varies from 2 to 12 feet in ordinary seasons. The expense of pumping is about $0.60 per acre-foot, not including interest on investment and deterioration of plant. The amount of water used during 1904 was accurately determined by W. D. Smith, and reported in Water-Supply Paper No. 134, page 42, under the head of "Duty of water and seepage investigations." Measurements made in 1903 are reported in Water-Supply Paper No. 100. During 1905 the zanjero used the same "irrigating head" as for the year preceding, his measurements being made by weirs. This was checked by a meter gaging on September 26, which gave a discharge of 34.1 second-feet. The engineer, H. H. Alexander, kept a record of the number of irrigating heads pumped every hour the pump was in operation during 1905. The following table is based on his record. The rainfall data were furnished by S. H. Hackett, of the United States Weather Bureau.

Monthly duty of water of the Colorado Valley Pumping and Irrigation Company's canal and rainfall at Yuma, Ariz., for 1905.

	Duty of water (acre-feet).			Rainfall (inches).
	Total.	Per acre, gross area.	Per acre, net area.	
January	220	0.03	0.10	1.15
February	250	.04	.11	3.43
March	0	.00	.00	3.33
April	1,180	.18	.51	.16
May	1,470	.23	.64	.00
June	1,240	.19	.54	.00
July	1,260	.19	.55	.00
August	1,550	.24	.67	.02
September	1,310	.20	.57	.52
October	530	.08	.23	.02
November	350	.05	.15	2.44
December	300	.05	.13	.32
Total irrigation	9,660	1.48	4.20	11.39
Total, including rainfall			5.15	

Mixed crops: Alfalfa, 1,350 acres; grain, 470 acres; corn and sorghum, 250 acres; miscellaneous, 230 acres. Total net area, 2,300 acres; total gross area, 6,500 acres; number of irrigators, 75. Average annual rainfall at Yuma, 3 inches.

The above includes loss by seepage.

FARMERS' CANAL NEAR YUMA, ARIZ.

This canal, the property of the Yuma Valley Union Land and Water Company, diverts water from Colorado River at a point 1 mile below Yuma, Ariz., for the purpose of irrigating lands in Yuma Valley.

Measurements have been made at the heading immediately at the river since May, 1903, by means of a boat and cable or by wading. As the point of gaging is above the controlling head gate, gage heights would be of no value for the purpose of constructing rating tables and no gage has been established. The height at any date may be obtained approximately by subtracting 1 foot from the gage reading at Yuma.

The canal is heavily silted, and during 1905 has been dry much of the time.

Results of measurements made in previous years are contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Farmers' Canal near Yuma, Ariz., for 1905.

Date.	Hydrographer.	Area of section.	Mean velocity.	Discharge.
		Sq. feet.	*Ft. per sec.*	*Sec.-ft.*
January 13	W. D. Smith	31	0.71	22
March 7	do	31	.58	18
May 11	do	67	1.91	128
June 30	do	37	2.27	84

LUDY CANAL NEAR YUMA, ARIZ.

This canal is the property of the Irrigation Land and Improvement Company. It diverts water from Colorado River at a point 3 miles below Yuma, Ariz., for the purpose of irrigating lands in Yuma Valley.

Miscellaneous measurements have been made at the heading since March, 1903. June 6, 1905, a gage was established and a nilometer placed on the canal by W. D. Smith, at the

second gate and bridge, which is 1 mile from the river. No water is taken from the can above this gate. The gage is nailed to the west wall of the flume below the bridge. The bench mark is a nail driven into the top of the west end of an 8 by 8 inch timber at the lower side of the bridge. Its elevation is 15.00 feet above the zero of the gage. The elevation of the top of the floor of the bridge at the southwest corner is 16.10 feet above the zero of the gage. Discharge measurements are made from the lower side of the bridge. The initial point is the east end of the 8 by 8 inch timber referred to above. The canal is straight both above and below the gate. The velocity of the cross section is fairly uniform. The gage height is not affected by any gates farther down the canal.

The canal is badly silted up and is dry much of the time at low water. During the floods of 1905 the banks were overflowed and considerably damaged.

Discharge measurements of Ludy canal near Yuma, Ariz., for 1905.

Date.	Hydrographer.	Area.	Mean velocity.	Gage height.	Discharge.
		Sq. ft.	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 21	W. D. Smith	405	0.90	.....	[illegible]
April 6	do	128	.18	.....	23
May 5	do	104	.64	.....	67
June 6	do	174	1.97	.....	343
June 17	do	799	2.42	12.60	1,932
July 11	do	235	1.15	10.40	271
July 15	do	152	.19	9.30	29

IMPERIAL CANAL AT HEADINGS IN UNITED STATES AND MEXICO.

General statement.—The original heading of the Imperial canal, designated in the following tables as heading No. 1, is located about 10 miles by Colorado River below Yuma, Ariz., on the California side, immediately above the international boundary line and opposite Pilot Knob Mountain. The California Development Company is now constructing a permanent gate on bed rock at a spur of this mountain in place of the wooden one now in use. During the summer of 1904 a second heading was made immediately below the boundary line, and in October of the same year an opening was made to the river at a point 4 miles below the boundary. This last opening is designated as heading No. 3. No gage was placed at either heading No. 2 or No. 3. The canal runs parallel to the river for the first 4 miles of its course, so that it was necessary to cut a channel only one-half mile long.

The first 12 miles of the canal was constructed; the remaining 40 miles is an old natural channel, called Alamo River. The whole length of the canal lies in the Colorado River delta, which is composed of loose, sandy soil, covered with a heavy growth of mesquite, willow, and arrowwood. The canal as a whole had a greater fall per mile than the river, but for the first 15 miles the fall was less than that in the river, and for this reason the canal had to be dredged constantly to keep it open. The exceptional floods of January, February, March, and April, 1905, scoured it out to a channel of considerable depth, and during the regular annual flood of May and June, which was unusually high and long, this scouring was continued to such an extent that when the flood began to recede and the river again began to deposit mud, the velocity in the canal was much greater than in the river below heading No. 3. The result was that the old river channel silted up heavily while the new channel, the canal from heading No. 3 down, was still scouring. As the old river channel filled with silt a greater proportion of the water went down the canal, increasing the velocity; and as the canal scoured deeper the amount and velocity of the water going down the old channel were decreased. These reactions were so great that the process of scouring a new channel, which had been going on slowly for several months, began to make rapid progress. The canal was widened in a few days from 100 to 300 or 400 feet. June 30 the total discharge of the river was 61,500 second-feet, 22 per cent of which went down the canal; July 8 the total

discharge was 37,200 second-feet, 67 per cent of which went down the canal. All efforts to stop the flood proved ineffectual.

Meter measurements have been made weekly during the year to determine the total amount of water diverted by the canal, the amount diverted in the United States, the amount diverted in Mexico, and the amount going down the old river channel.

Besides miscellaneous gagings farther down the canal, measurements were made at five points, as follows: Heading No. 1, heading No. 2, heading No. 3 above its junction with the original canal (giving discharge of heading No. 3 alone), heading No. 3 below the junction (giving the total discharge of the canal), and the old channel of the Colorado below heading No. 3. At all of these stations except the last the conditions are constantly changing. The banks are washing away or being filled in, and the bed is silting up or scouring out and being dredged out. For these reasons it has been necessary to put in new gages often. The frequent passage of barges and dredges has rendered the maintenance of permanent cables impracticable, and a light cable has been stretched for each gaging. Measurements each week have been made at such points as would give the desired results, directly or indirectly, with the least expenditure of time and money.

The total discharge of the canal during 1905 was obtained as follows: From January 1 to March 10 by direct meter measurements at heading No. 3 below the junction; from March 11 to June 30 by adding discharges of headings Nos. 1, 2, and 3; from July 1 to December 31 by subtracting the discharge of the old channel below heading No. 3 from the discharge of Colorado River at Yuma. To obtain the discharge of the old channel below heading No. 3 on the dates when it was not measured directly, the total discharge of the canal was subtracted from the discharge of the Colorado at Yuma.

The mean discharge of heading No. 1 for each month was obtained by averaging results of meter measurements. The mean discharge of the whole canal for each month was obtained in the same way. Measurements for the first ten months are so well distributed that they are given equal weight. On account of the flood of November 29, the estimate for November and December is based on an interpolation of the percentage of the total flow of the river diverted by the canal. As the flood in the old channel lasted only five days, any error from this method of calculation is not great.

The monthly summary of the discharge of headings Nos. 2 and 3, showing total diversion made in Mexico, is obtained by subtracting the discharge of heading No. 1 from the total. The monthly summary of the discharge of the old channel below heading No. 3 is obtained by subtracting the total discharge of the canal from the discharge of Colorado River at Yuma.

No gage observer was obtainable for the three lower stations, but gage-height records were kept at headings Nos. 1 and 2.

June 15, 1904, a waste gage was put in operation at a point 12 miles below heading No. 1, called the Quail River waste gate. Water going through this gate passes through Quail River into Padrones River and thence into Volcano Lake. Volcano Lake has two outlets—New River, which discharges into Salton Basin, and Hardy River, which discharges into the Gulf of California through the old channel of the Colorado. March 20, 1905, the flood silted up the channel leading from the waste gate and no more water has been diverted from the canal at this point.

After the flood of November 29, 1905, a channel was dredged from the canal to Quail River from a point 15 miles below heading No. 1, and a considerable amount of water diverted to Padrones River and Volcano Lake. All the water going down the canal past this point discharges through Alamo and New rivers into Salton Basin, except what is lost by seepage and used for irrigation in the Imperial Valley.

The results of the discharge measurements made at the two waste channels mentioned above will be found in the list of miscellaneous discharge measurements.

Heading No. 1.—This station was established October 24, 1903. It is located half a mile from the river, 600 feet below the wooden head gates, and is 10 miles by river below Yuma, Ariz., on the California side.

The channel is straight for 600 feet above and 300 feet below the cable and has a width of 70 feet. The right bank is low and is liable to overflow; the left bank has an elevation of 6 feet above high water. The bed of the canal is composed of silt and sand, is free from vegetation, and is very unstable. There is but one channel at all stages, but when the gage at Yuma reads about 26 feet the river overflows into the channel below the gaging section. The current has a moderate velocity.

Discharge measurements are made by means of a boat and cable. The initial point for soundings is a charred post at the southeast corner of the corral about 150 feet west of the right bank.

A vertical gage, which is read twice each day by J. S. Carter, is located just above the international boundary line, on the right bank. The gage is referred to bench marks as follows: (1) A standard United States Geological Survey iron bench-mark post, located near monument 207 of the United States and Mexico boundary line, on a hill about half a mile west of the gaging station; elevation, 52.41 feet above the zero of the gage and 155 feet above sea level. (2) A nail in a tree on the right bank; elevation, 15.20 feet above the zero of the gage. (3) A nail in a post near the ground on the right bank near the corral; elevation, 14.90 feet above the zero of the gage.

The canal at this heading is filled with mud and has been temporarily abandoned, but some flood water passed through it during 1905 and was carefully measured.

Heading No. 2.—This heading diverts water from Colorado River at a point in Mexico 50 feet below the international boundary line, 400 feet below heading No. 1, and 10 miles by river from Yuma, Ariz. The station was established January 12, 1905, and weekly discharge measurements were made until August 31, 1905.

The channel is straight for 200 feet above and 600 feet below the cable and is about 80 feet wide. The bed and banks are composed of clay and silt and are unstable. There is but one channel at all stages, but when the gage in Yuma reads about 28 feet the river overflows into the canal below the gaging section. As the canal from heading No. 1 joins this canal about 800 feet below the gage rod, the two gages read about the same.

Discharge measurements are made by means of a boat and cable. The initial point for soundings is a clump of three willow trees growing near the north bank 200 feet below the gage.

A vertical rod gage, which is read daily by A. H. Chance, is driven into the north bank of the canal at a point 50 feet from the river. The bench marks and the elevation of the zero of the gage are the same as for heading No. 1.

Heading No. 3 (above the junction).—This heading or intake is in Mexico, 4 miles below the California-Mexico boundary line and 14 miles by Colorado River below Yuma, Ariz. The station was established March 8, 1905. The point of gaging is about one-half mile from the river and 150 feet above the junction of heading No. 3 with the original canal. Gagings at this point give the discharge of heading No. 3 alone.

The channel is straight for 500 feet above the point of gaging and nearly straight for 500 feet below. In the highest floods the banks are overflowed both above and below the station. The cross section is regular, the bed is unstable, and the current is swift. During July, 1905, the flood widened the channel from 100 to 300 feet and lowered the bed about 10 feet.

Discharge measurements are made by means of a boat and cable. The initial point for soundings, a willow stake on the north bank, was washed away by the flood in July, 1905.

The gage and bench marks are the same as for heading No. 3 below the junction. described below. The gage height is an indication of the total discharge of the canal and not of this heading alone.

Heading No. 3 (below the junction).—This station was established October 7, 1904. The point of gaging is about one-half mile from the river and 300 feet below the junction of heading No. 3 with the original canal. Gagings at this point give the total discharge of the canal.

The channel is straight for 300 feet above and 500 feet below the cable. The banks are subject to overflow. The cross section is regular. The bed of the canal is composed of silt and sand and is very unstable. During July, 1905, the canal, which at this point was about 100 feet wide, was scoured out to a width of 400 feet and the depth increased about 8 feet.

Discharge measurements are made by means of a boat and cable.

The gage is a vertical rod on the south bank and is referred to bench marks as follows: (1) A nail in the central one of three willow trees 20 feet from the bank and 100 feet above the gage; elevation, 15.83 feet above the zero of the gage. This bench mark was originally 2 feet above the surface of the ground but is now 2 feet below, as soil was deposited here to a depth of about 4 feet by the flood of March 20, 1905. (2) A nail on the north side of a large willow stump 100 feet south of the south bank and 500 feet upstream from the gage; elevation, 22.26 feet above the zero of the gage.

Information in regard to this canal is contained in the following Water-Supply Papers of the United States Geological Survey: 85, p. 77; 100, pp. 27-29; 134, pp. 26-39.

Discharge measurements made at the Imperial canal headings during 1905.

Date.	Heading No. 1.	Heading No. 2.	Heading No. 3.		Total discharge of canal.
			Above junction.	Below junction.	
January 12		380		900	900
January 26	90	350		990	990
February 8				6,690	6,690
February 14	460	900		2,480	2,480
February 28				3,100	3,100
March 8	1,110	1,530	1,180	3,600	3,600
March 18	1,270	2,200	1,530		5,000
March 21	2,590	2,240	1,920		6,750
March 28	530	1,180	1,750		3,460
April 6	450	1,190	1,650		3,290
April 20	760	1,190	2,610		4,560
April 27	460	1,100			
May 3	180	1,470	3,360		5,010
May 11		1,940	4,160		6,100
May 17		1,580	3,780		5,360
May 25		1,790	3,560		5,350
June 1		2,240	4,500		6,740
June 7		2,660	5,830		8,490
June 15		2,700	6,130		8,830
June 23		3,260	6,880		10,140
June 30	390	3,140	10,430		13,960
July 8				[a] 25,000	[a] 25,000
July 20		1,720	15,480		17,200
July 25			11,220		
August 3		840			
August 10		750			
August 18		480			
August 24		440			
August 31		470			

[a] Estimated.

NOTE.—Figures in first four columns represent measurements; figures in fifth column are derived from the preceding. For discharge of canal July 25 to December 31, see following table.

Portion of Colorado River diverted by Imperial canal during 1905.

Date.	Discharge of Colorado River in second-feet.		Diversion by Imperial canal.	
	At Yuma.	Below heading No. 3. of Imperial canal.	Second-feet.	Per cent.
January 12	6,300	5,400	900	14
January 26	6,770	5,780	990	15
February 8	62,080	55,390	6,690	11
February 14	21,900	19,420	2,480	11
February 28	25,000	21,900	3,100	12
March 8	43,100	39,500	3,600	8
March 18	62,400	57,400	5,000	8
March 21	103,500	96,750	6,750	7
March 28	29,500	26,040	3,460	12
April 6	30,100	26,810	3,290	11
April 20	43,400	38,840	4,560	11
May 3	39,700	34,690	5,010	13
May 11	52,000	45,900	6,100	12
May 17	37,000	31,640	5,360	14
May 25	43,700	38,350	5,350	12
June 1	61,500	54,760	6,740	11
June 7	69,500	61,010	8,490	12
June 15	82,000	73,170	8,830	11
June 23	89,800	79,660	10,140	11
June 30	61,500	47,540	13,960	23
July 8	37,200	12,200	[a] 25,000	67
July 12	31,720	11,610	20,110	63
July 20	22,250	5,050	17,200	77
July 25	20,650	[a] 8,150	[a] 12,500	61
July 30	17,500	2,480	15,020	86
August 3	14,700	2,000	12,700	86
August 10	16,200	2,220	13,980	86
August 18	10,300	1,170	9,130	89
August 24	7,550	770	6,780	90
August 31	7,500	560	6,940	93
September 7	5,060	90	4,970	98
September 14	9,670	1,230	8,440	87
September 22	6,080	180	5,900	97
September 28	5,280	40	5,240	99
October 11	12,950	1,010	11,940	92
October 18	6,950	25	6,925	99½
October 25	5,970	.....	5,970	100
October 30	5,670	.....	5,670	100
November 4	5,750	.....	5,750	100
November 11	6,550	.....	6,550	100
November 18	6,560	90	6,470	99
November 25	6,550	200	6,350	97
November 30	102,700	[a] 70,000	[a] 32,700	32
December 7	20,100	880	19,220	96
December 13	10,200	.....	10,200	100
December 17	8,100	.....	8,100	100
December 23	7,600	.....	7,600	100
December 31	5,900	.....	5,900	100

[a] Approximate.

Estimated monthly discharge of Imperial canal during 1905.

Month.	Heading No. 1, including total diversion in United States.		Headings Nos. 2 and 3, including total diversion in Mexico.		Total discharge.	
	Second-feet.	Total in acre-feet.	Second-feet.	Total in acre-feet.	Second-feet.	Total in acre-feet.
January	45	2,770	900	55,330	945	58,100
February	460	25,550	3,630	201,600	4,090	227,200
March	1,370	84,240	3,330	204,800	4,700	289,000
April	555	33,020	3,370	200,500	3,925	233,600
May	20	1,230	5,435	334,200	5,455	335,400
June	200	11,900	9,430	561,100	9,630	573,000
July	130	7,990	17,840	1,097,000	17,960	1,105,600
August			9,905	609,000	9,905	609,000
September			6,140	365,400	6,140	365,400
October			7,625	468,800	7,625	468,800
November			8,400	500,000	[a] 8,400	[a] 500,000
December			12,200	750,000	[a] 12,200	[a] 750,000
The year	232	166,700	7,350	5,348,000	7,582	5,514,000

[a] Approximate.

IMPERIAL VALLEY CANALS.

In July, 1904, stations were established on all canals entering the Imperial Valley, as follows: Holt canal, Hemlock canal, Alamo channel, Alamitos canal, Main canal, and Boundary canal. These stations are located on United States territory, and each is near the California-Mexico boundary line.

Discharge measurements are made from footbridges constructed at each station.

The gages are vertical 4 by 4 inch timbers substantially embedded in the ground. Automatic water-stage registers, from which the daily gage-height record is compiled, were placed at the first five stations mentioned above. These canals enter the valley east of Calexico, Cal.

In October a canal, known as canal No. 6, or Wisteria canal, was completed, which enters the valley west of Calexico, Cal. A station was established on this canal in November and weekly discharge measurements made. After April 11, 1905, the Holt canal supplied a much larger district than originally, covering territory which had been taking its supply from Alamo channel, near Eastside levee. A new canal, known as New Holt or No. 7, was built to replace the Holt, and a station was established in May. A station was also established on the Tamareck canal in June. The latter canal diverted water from New River to a district on the west side of New River below Imperial, which formerly obtained its supply from Main canal. Gages were established at both of these stations, but no automatic registers were placed on either canal.

The station on Alamo channel was inaccessible after the end of February on account of the flooded condition of the country. Water was not taken from the Alamo for irrigation after March. Discharge measurements were also made at Rockwood, on Alamo River, but no gage heights were kept. They show the amount of water flowing through this channel to Salton Sea.

Measurements were made at Brawley, on New River, for a similar purpose. They were made under such difficulties, however, that they are of little value. Measurements made at Calexico were used to determine the waste into Salton Sea, since the only diversion was through Tamarack canal. A large quantity of water was wasted from Main canal into New River below the gaging station at Calexico; this waste was measured and added to the discharge of New River in making estimate of total discharge of New River into Salton Lake.

A description of these stations, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey, pages 29–39.

Discharge measurements of Holt canal, near Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 4	W. V. Hardy	1.30	19.5	June 26	R. R. McCoslin	1.64	50
January 12	do	1.41	30	July 3	do	0.38	6.9
January 19	do	1.43	28	July 10	do	.33	6.1
January 26	do	1.23	19.5	July 17	do	.35	5.8
February 2	do	1.23	18.1	July 24	do	.36	4.8
February 9	do	1.07	13.5	July 31	do	.36	4.2
February 17	do	1.90	40	August 7	do	1.45	30
February 24	do	.93	11.1	August 14	do	1.25	38
March 13	R. R. McCoslin	1.88	51	August 21	do	.....	85
March 20	do	2.06	64	August 21	do	.039	5.1
March 27	do	2.84	118	August 28	do	2.62	133
April 3	do	2.81	131	September 4	do	2.67	131
April 10	do	1.13	21	October 10	W. V. Hardy	3.08	169
April 17	do	3.70	246	October 17	do	.25	2
April 24	do	3.70	256	October 23	do	2.65	128
May 1	do	3.37	202	November 6	do	1.40	21
May 8	do	2.76	143	November 13	do	1.51	35
May 15	do	2.91	163	November 20	do	1.33	40
May 22	do	2.92	169	November 29	do	1.31	22
May 29	do	2.70	128	October 30	do	2.55	124
June 5	do	2.86	150	September 11	do	2.88	159
June 12	do	3.02	177	September 25	do	2.75	128
June 18	do	1.69	57	October 2	do	2.80	137

Mean daily gage height, in feet, of Holt canal, near Calexico, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(1.0)	1.25	1.4	2.85	3.3	2.8	0.0	0.35	3.05	2.8	2.0	1.3
2	(1.0)	1.25	1.3	2.9	3.25	2.85	.0	.35	3.0	2.8	1.7	2.6
3	(1.2)	1.25	(1.45)	2.8	3.3	2.8	.4	.35	2.75	2.8	1.7	2.8
4	(1.3)	1.25	(1.6)	2.5	3.2	2.8	.35	.5	2.65	2.85	1.7	3.0
5	(1.3)	1.25	(1.4)	2.6	2.9	2.85	.35	1.15	2.7	2.85	1.5	3.0
6	(1.5)	1.3	1.4	3.05	(2.75)	2.95	.35	1.45	2.9	2.95	1.4	2.95
7	(1.5)	1.15	1.55	(3.3)	(2.75)	3.0	.35	1.55	2.7	3.1	1.35	2.9
8	(1.5)	(1.1)	1.7	(3.25)	2.75	2.95	.35	1.65	2.5	3.1	1.35	2.9
9	(1.5)	1.05	1.8	(3.25)	2.75	3.0	.35	1.65	2.75	3.15	1.35	2.85
10	(1.5)	1.05	1.65	2.15	2.75	3.05	.35	1.65	2.85	3.05	1.4	2.7
11	(1.5)	1.05	(1.8)	3.6	2.75	3.0	.35	1.55	2.9	3.15	1.45	2.7
12	1.4	1.0	(1.9)	3.65	2.8	2.95	.35	1.35	3.0	1.25	1.5	.....
13	1.4	1.2	1.95	3.6	2.9	2.6	.35	1.3	3.1	.25	1.55	.....
14	1.35	1.4	2.0	3.55	2.9	2.5	.35	1.25	3.05	.25	1.7	.....
15	1.35	1.6	1.55	3.65	2.85	2.5	.35	1.1	3.0	.25	1.1	.....
16	1.35	1.75	1.3	3.65	2.9	2.5	.35	.95	3.1	.25	.95	.....
17	1.35	1.8	1.5	3.7	2.85	2.5	.35	.95	3.15	.25	.9	.....
18	1.35	1.35	1.55	3.8	2.85	1.75	.35	.95	3.1	.25	.9	.....
19	1.4	1.4	1.95	3.75	2.9	1.7	.35	1.0	2.6	.25	.85	.....
20	1.55	1.4	1.8	3.8	2.9	1.65	.35	1.0	2.3	1.2	1.05	.....
21	1.65	1.4	1.85	3.75	2.95	1.65	.35	1.05	2.75	1.3	.95	.....
22	1.7	1.4	2.05	3.75	2.95	1.6	.35	1.5	2.95	1.5	.9	.....
23	1.6	1.4	2.2	3.75	2.7	1.65	.35	1.95	2.9	2.65	.95	.....
24	(1.45)	.95	2.35	3.7	2.6	1.6	.35	2.0	2.8	2.65	1.0	.....
25	1.3	1.1	2.2	3.5	2.5	1.65	.35	2.0	2.0	2.7	.95	.....
26	(1.25)	1.4	(2.6)	3.35	2.45	1.65	.35	2.0	1.35	2.7	.95	.....
27	1.1	1.55	2.85	3.35	2.5	0	.35	2.0	2.25	2.7	85	.....
28	.95	1.5	2.8	3.35	2.55	0	.35	2.6	2.8	2.7	.8	.....
29	1.0	.....	2.6	3.35	2.9	0	.35	2.7	2.8	2.6	.9	.....
30	(1.1)	.....	2.7	3.35	2.7	0	.35	2.75	2.8	2.4	1.25	.....
31	(1.2)	.....	2.80	.....	2.65	.....	.35	2.85	.....	2.3	.....	.....

NOTE.—Gage heights in parentheses are estimated.

Estimated monthly discharge of Holt canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum	Minimum	Mean.	
January	40	10	24.8	1,525
February	35	9	21.0	1,166
March	123	23	57.4	3,530
April	260	83	208	12,380
May	210	109	152	9,346
June	181	0	[a] 150	8,926
July	7	0	[a] 150	9,223
August	158	3	[a] 150	9,223
September	202	35	144	8,569
October	196	2	96.6	5,940
November	71	8	27.0	1,607
The period				71,430

[a] Estimated. Flood water used for irrigation. Beginning with March 6 Holt heading was used to divert water in No. 5 main canal, but its capacity was not sufficient until April 16.

Estimated monthly discharge of New Holt or No. 7 canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May			18	1,107
June			33	1,964
July			33	2,029
August			33	2,029
September			33	1,964
October			33	2,029
November			33	1,964
The period				13,090

NOTE.—The station record is of no value because most of the water used was obtained from flooded basins to the east. The mean discharge for the entire district covered by the canal was estimated in the field at 33 second-feet.

Discharge measurements of Hemlock canal near Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 4	W. V. Hardy	0.87	2.0	June 26	R. R. McCoslin	1.96	21.0
January 12	do	0.88	2.2	July 3	do	1.23	7.2
January 19	do	1.41	9.5	July 10	do	1.73	17.9
January 26	do	0.84	1.9	July 17	do	1.69	15.9
February 2	do	1.25	7.4	July 24	do	0.75	0.8
February 9	do	1.64	16.4	July 31	do	1.23	7.9
February 17	R. R. McCoslin	1.59	12.5	August 7	do	1.43	12.7
February 24	do	1.79	17.2	August 14	do	1.59	17.4
March 13	do	1.20	8.7	August 21	do	1.23	9.8
March 20	do	1.45	13.2	August 28	do	1.12	7.3
March 27	do	1.73	23.0	September 4	W. V. Hardy	0.97	4.4
April 3	do	1.85	20.0	September 11	do	1.42	13.3
April 10	do	1.42	12.7	September 25	do	0.82	2.1
April 17	do	2.45	36.0	October 2	do	1.11	7.3
April 24	do	0.70	1.6	October 10	do	1.30	8.3
May 1	do	1.10	6.4	October 17	do	1.12	8.0
May 8	do	2.04	20.4	October 23	do	1.20	8.4
May 15	do	1.94	18.6	October 30	do	1.04	5.2
May 22	do	1.75	14.5	November 6	do	0.90	4.0
May 29	do	1.54	12.1	November 13	do	1.00	6.4
June 5	do	1.81	16.9	November 20	do	0.70	2.0
June 12	do	0.78	2.1	November 29	do	0.89	3.1
June 18	do	1.7	13.2				

Mean daily gage height, in feet, of Hemlock canal near Calexico, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	1.0	0.9	(1.8)	1.1	1.55	1.6	1.2	1.15	1.0	1.1	1.0
2	.9	1.25	.9	1.9	1.05	1.55	1.5	1.2	1.1	1.1	1.15	1.0
3	.95	1.3	.9	1.85	1.2	1.6	1.25	1.2	.9	1.1	1.25	2.0
4	1.0	1.3	.9	1.8	1.35	1.7	1.2	1.3	.95	1.15	1.1	1.5
5	1.05	1.1	1.05	2.0	1.7	1.8	1.2	1.3	1.2	1.2	.95	1.5
6	1.15	.8	1.25	(2.0)	1.95	1.9	1.2	1.4	1.35	1.3	.9	1.7
7	1.3	.8	1.3	(1.9)	2.0	1.95	1.55	1.45	1.35	1.45	.9	1.65
8	1.4	1.0	1.3	(1.6)	2.1	2.05	1.75	1.4	1.35	1.45	.9	1.6
9	1.0	1.65	1.5	(1.5)	2.1	2.1	1.75	1.4	1.35	1.4	.95	1.55
10	.75	1.65	1.25	(1.4)	2.1	2.15	1.75	1.4	1.4	1.35	1.0	1.6
11	.75	1.55	1.25	(1.6)	2.1	2.15	1.75	1.5	1.4	1.4	1.05	.....
12	.75	1.35	1.3	(1.7)	2.1	.8	1.75	1.55	1.45	1.35	1.1	.....
13	.75	1.1	1.2	1.9	2.1	.8	1.7	1.55	1.5	1.5	1.05	.....
14	.75	1.15	1.05	1.8	2.1	.9	1.7	1.6	1.55	1.0	.95	.....
15	.75	1.4	.95	2.0	1.95	.9	1.7	1.4	1.55	1.15	.75	.....
16	.75	1.8	.9	(2.2)	2.0	.9	1.7	1.25	1.55	1.25	.8	.....
17	.75	1.6	1.05	2.45	1.95	1.4	1.7	1.2	1.55	1.1	.8	.....
18	1.0	1.75	1.0	2.5	1.85	1.7	1.8	1.2	1.3	1.0	.85	.....
19	1.4	1.75	1.05	2.2	1.85	1.65	1.85	1.2	.95	1.05	.8	.....
20	1.55	1.65	1.45	2.45	1.8	1.6	1.45	1.2	1.0	1.1	.7	.....
21	(1.4)	1.5	1.5	2.35	1.75	1.55	1.0	1.25	1.05	1.0	.8	.....
22	(1.3)	1.45	1.4	2.2	1.75	1.5	1.0	1.2	1.0	1.0	.9	.....
23	(1.2)	1.55	1.25	(2.0)	1.7	1.5	1.0	1.2	1.0	1.2	.85	.....
24	(1.0)	1.8	1.3	1.45	1.75	1.75	.75	1.2	.9	1.15	.75	.....
25	(.9)	1.65	1.55	1.45	(1.7)	1.95	.75	1.2	.95	1.05	.75	.....
26	.85	1.05	1.55	1.2	(1.65)	1.85	.75	1.2	1.0	1.05	.75	.....
27	1.0	.9	1.75	1.1	(1.6)	1.8	.75	1.2	1.0	1.1	.75	.....
28	1.0	.9	1.55	1.1	(1.55)	1.8	1.05	1.1	.9	1.1	.85	.....
29	.7	.....	1.15	1.1	1.5	1.75	1.25	1.1	.95	1.2	.95	.....
30	.6	.....	1.5	1.1	1.55	1.75	1.25	1.05	.95	.9	1.3	.....
31	.55	.....	1.9	.....	1.6	.....	1.25	1.0	.....	.85	.....	.....

NOTE.—Gage heights in parentheses are estimated.

Estimated monthly discharge of Hemlock canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	12.0	0.4	4.3	264
February	17.4	2.0	10.0	555
March	23.0	3.3	10.7	658
April	39.0	6.6	19.3	1,149
May	21.6	5.4	15.7	965
June	25.2	1.8	14.1	839
July	18.4	0.8	10.9	670
August	17.5	5.2	10.4	639
September	14.0	3.3	8.1	482
October	12.6	2.4	7.5	461
November	9.6	1.4	4.6	274
The period	.....	.....	.....	6,955

Discharge measurements of New River near Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 5	W. V. Hardy	2.00	12	May 23	R. R. McCoslin	9.24	3,[illegible]
January 13	do	3.20	82	May 30	do	9.38	3,[illegible]
January 20	do	3.30	99	June 6	do	9.77	3,[illegible]
January 27	do	5.20	323	June 13	do	10.85	4,[illegible]
February 3	do	4.00	126	June 20	do	11.81	[illegible]
February 10	do	5.70	451	June 27	do	12.70	10,[illegible]
February 18	do	6.90	986	July 5	do	13.21	11,94[illegible]
February 23	R. R. McCoslin	7.14	1,063	July 12	do	13.34	13,[illegible]
March 2	do	7.48	1,461	July 18	Hardy and McCoslin	13.11	13,[illegible]
March 9	do	7.90	1,702	July 25	do	12.42	10,[illegible]
March 16	do	7.77	1,648	August 1	R. R. McCoslin	11.38	[illegible]
March 23	do	6.74	1,159	August 8	McCosland and Hardy	10.72	[illegible]
March 29	do	8.93	2,916	August 15	do	10.90	[illegible]
April 6	do	6.95	1,307	August 22	do	10.22	[illegible]
April 12	do	6.50	949	August 29	M. V. Hardy	9.42	4,[illegible]
April 18	do	6.80	1,149	September 5	Hardy and McCoslin	9.31	3,[illegible]
April 25	do	8.71	3,052	September 12	do	7.52	[illegible]
May 2	do	8.47	2,417				
May 9	do	8.80	2,890				
May 16	do	9.19	3,237				

Discharge measurements of Alamo Channel near Rockwood, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 7	W. V. Hardy		49	May 17	R. R. McCoslin	6.00	9[illegible]
January 14	do		205	May 24	W. V. Hardy	6.37	1,[illegible]
January 21	do		77	May 31	do	5.92	1,[illegible]
January 28	do		112	June 7	do	6.28	2,1[illegible]
February 4	do		151	June 14	do	6.85	3,644
February 11	do		61	June 21	do		[illegible]
February 20	do		530	June 28	do	9.60	3,[illegible]
February 25	do		94	July 6	do	9.00	4,[illegible]
March 3	do	7.48	387	July 13	do	9.50	[illegible]
March 11	do	6.80	1,088	July 19	do		[illegible]
March 17	do	7.15	1,379	July 26	do		[illegible]
March 25	do	10.00	1,806	August 2	do	8.80	[illegible]
March 30	do	9.50	1,443	August 9	do	8.60	[illegible]
April 8	do	6.20	635	August 16	do	8.50	[illegible]
April 13	do	6.00	692	August 23	do	9.80	[illegible]
April 19	R. R. McCoslin	6.00	772	August 30	do	9.93	[illegible]
April 26	do	(a)	a 632	September 6	Hardy and McCoslin	9.95	2,115
May 3	do		1,044	September 13	do	10.45	3,[illegible]
May 10	do		1,770				

a Gage washed out.

Discharge measurements of Alamitos canal, Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 3	W. V. Hardy	1.48	30	June 12	R. R. McCoslin	1.32	37
January 11	do	1.54	39	June 18	W. V. Hardy	1.30	30
January 18	do	1.11	15.1	June 26	R. R. McCoslin	1.35	36
January 26	do	1.05	12.9	July 5	do	1.33	34
February 2	do	1.06	13.6	July 10	do	1.34	33
February 9	do	0.52	1.0	July 17	do	1.35	34
February 17	R. R. McCoslin	1.05	16.8	July 24	do	1.34	33
February 24	do	1.00	15.7	July 31	do	1.34	33
March 1	do	0.82	9.1	Aug. 7	do	1.12	22
March 8	do		0	August 14	do	1.12	22
March 15	do		0	August 21	do	1.17	24
March 22	do		0	August 28	do	1.27	31
March 29	do	1.20	24	September 4	do	1.34	39
April 5	do	1.53	44	September 11	W. V. Hardy	1.42	43
April 11	do	1.63	50	September 25	do	1.23	36
April 17	do	1.67	57	October 9	do	1.30	40
April 24	do	1.39	40	October 16	do	1.32	45
May 1	do	1.10	26	October 23	do	1.27	38
May 8	do	1.15	28	November 13	do		0
May 15	do	1.41	39	November 18	do		0
May 22	do	1.34	35	November 30	do	0.42	5.4
May 29	do	1.37	36	October 30	do	0.90	18.3
June 5	do	1.35	36	November 6	do		0

Mean daily height in feet, of Alamitos canal near Calexico, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	1.2	0.8	1.35	1.1	1.35	1.3	1.05	1.4	1.1	0.45	0.2
2	1.5	1.1	.8	1.5	1.1	1.35	1.3	.9	1.4	1.25	.45	.25
3	1.5	1.25	.6	1.6	1.1	1.35	1.35	1.05	1.35	1.15	.2	.25
4	1.45	1.1	.4	1.55	1.1	1.35	1.35	1.1	1.35	1.3	.1	.2
5	1.45	.95	.35	1.5	1.1	1.35	1.35	1.1	1.3	1.3	.0	.2
6	1.4	.95	.35	1.55	1.1	1.35	1.35	1.1	1.35	1.3	.15	.2
7	1.45	.95	.3	1.6	1.1	1.35	1.35	1.1	1.45	1.25	.25	.2
8	1.5	.9	.1	1.6	1.15	1.35	1.35	1.1	1.45	1.25	.3	.2
9	1.6	.7	.1	1.6	1.2	1.3	1.35	1.15	1.4	1.25	.3	.2
10	1.6	.5	.1	1.65	1.25	1.35	1.35	1.15	1.4	1.25	.3	.2
11	1.6	.5	.1	1.65	1.3	1.3	1.35	1.15	1.4	1.25	.25	.2
12	1.6	.5	.1	1.65	1.4	1.3	1.35	1.15	1.45	1.25	.3	.25
13	1.6	.5	.1	1.65	1.4	1.3	1.35	1.15	1.5	1.25	.3	.....
14	1.7	.5	.1	1.65	1.4	1.35	1.35	1.1	1.45	1.3	.25	.....
15	1.45	.55	.0	1.65	1.4	1.35	1.35	1.1	1.4	1.3	.3	.....
16	1.5	.65	.0	1.65	1.3	1.35	1.35	1.1	1.4	1.35	.3	.....
17	1.15	1.05	.0	1.65	1.2	1.3	1.35	1.1	1.4	1.35	.25	.....
18	1.1	1.05	.0	1.7	1.2	1.3	1.35	1.1	1.4	1.35	.2	.....
19	1.1	1.05	.0	1.75	1.2	1.3	1.35	1.15	1.35	1.25	.2	.....
20	1.1	1.05	.0	1.35	1.25	1.3	1.35	1.2	1.4	1.2	.2	.....
21	1.05	1.05	.0	1.4	1.35	1.3	1.35	1.2	1.45	1.2	.15	.....
22	1.1	1.05	.0	1.55	1.35	1.3	1.35	1.15	1.45	1.15	.15	.....
23	1.1	1.0	.15	1.45	1.35	1.3	1.35	1.2	1.4	1.25	.15	.....
24	1.1	1.0	.65	1.4	1.35	1.3	1.35	1.25	1.2	1.25	.2	.....
25	1.0	1.05	.7	1.4	1.35	1.35	1.35	1.25	1.25	1.2	.25	.....
26	1.05	1.1	.7	1.4	1.35	1.35	1.35	1.25	1.25	1.2	.25	.....
27	1.15	.8	.85	1.4	1.35	1.35	1.35	1.3	1.2	1.15	.35	.....
28	1.2	.75	.9	1.25	1.35	1.35	1.35	1.3	1.1	1.15	.4	.....
29	1.2	.....	1.3	1.15	1.35	1.35	1.35	1.3	1.15	1.15	.35	.....
30	1.2	.....	1.4	1.15	1.35	1.3	1.35	1.25	1.1	.9	.25	.....
31	1.25	.....	1.3	.....	1.35	.....	1.35	1.3	.....	.8	.....	.....

Estimated monthly discharge of Alamitos canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	50	11	26.6	1,636
February	23	.5	11.4	633
March	36	0	4.9	301
April	65	28	45.6	2,714
May	40	25	31.8	1,955
June	38	30	34.4	2,047
July	35	32	33.9	2,084
August	34	11	23.9	1,470
September	49	28	40.8	2,428
October	47	18	35.8	2,201
November	6	0	2.7	161
The period	.....	.....	.....	17,630

Discharge measurements of Main canal near Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
January 3	W. V. Hardy	3.90	439	June 12	R. R. McCoslin	4.17	575
January 11	do	4.20	524	June 18	do	4.17	540
January 18	do	4.50	567	June 26	do	4.23	571
January 26	do	4.20	510	July 3	do	4.25	572
February 2	do	4.18	507	July 10	do	4.38	567
February 15	do	4.09	485	July 17	do	4.36	582
February 17	R. R. McCoslin	4.15	472	July 24	do	4.32	583
February 23	do	3.95	447	July 31	do	4.23	580
March 1	do	4.49	595	August 7	do	4.29	556
March 8	do		0	August 14	do	4.33	562
March 15	do		0	August 21	do	4.33	540
March 22	do	3.52	410	August 28	do	4.29	536
March 29	do	4.79	651	September 4	do	4.30	558
April 5	do	4.84	675	September 11	W. V. Hardy		0
April 11	do	4.98	729	September 25	do	4.27	551
April 17	do	5.04	735	October 2	do		0
April 24	do	4.91	725	October 9	do	4.29	559
May 1	do	4.47	648	October 16	do	4.30	546
May 8	do	4.42	623	November 3	do	2.90	298
May 15	do	4.34	586	November 6	do	3.60	380
May 22	do	4.24	562	November 13	do	3.60	380
May 29	do	4.32	595	November 18	do	3.55	378
June 5	do	4.19	566	November 30	do	3.50	376

Mean daily gage height, in feet, of Main canal near Calexico, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.9	4.05	4.5	4.7	4.45	4.2	4.25	4.2	4.3	(a)	2.3	3.4
2	3.95	4.2	4.45	4.85	4.4	4.2	4.25	4.2	4.3	(a)	2.9	3.45
3	3.9	4.25	4.05	4.95	4.4	4.2	4.25	4.2	4.3	(a)	3.22	3.75
4	3.85	4.15	(a)	4.9	4.4	4.2	4.25	4.25	4.3	(a)	3.55	3.5
5	3.85	3.95	(a)	4.85	4.45	4.2	4.25	4.25	4.3	3.95	3.45	3.9
6	3.75	3.8	(a)	4.9	4.4	4.2	4.25	4.25	4.3	4.2	(3.55)	3.95
7	3.7	3.8	(a)	4.95	4.4	4.2	4.3	4.3	(a)	4.25	(3.6)	3.95
8	3.75	3.8	(a)	4.95	4.45	4.2	4.35	4.3	(a)	4.2	(3.6)	3.95
9	3.95	3.85	(a)	5.0	4.45	4.2	4.35	4.3	(a)	4.3	(3.6)	3.95
10	4.2	3.85	(a)	5.0	4.4	4.2	4.35	4.3	(a)	4.3	(3.6)	3.6
11	4.2	3.85	(a)	5.0	4.4	4.2	4.35	4.35	(a)	4.3	3.6	.....
12	4.4	3.85	(a)	5.0	4.45	4.2	4.35	4.35	.5	4.3	3.6	.....
13	4.55	3.8	(a)	5.0	4.45	4.2	4.35	4.35	2.0	4.3	3.6	.....
14	4.4	3.95	(a)	5.0	4.4	4.25	4.35	4.35	2.5	4.3	3.6	.....
15	4.3	4.1	(a)	5.05	4.35	4.2	4.35	4.35	2.95	4.3	(3.6)	.....
16	4.35	4.2	(a)	5.05	4.3	4.2	4.35	4.35	3.1	4.35	(3.6)	.....
17	4.4	4.1	(a)	5.05	4.3	4.25	4.35	4.35	3.15	4.35	(3.6)	.....
18	(4.5)	4.05	(a)	5.1	4.3	4.2	4.35	4.35	3.15	4.35	3.6	.....
19	4.5	4.05	(a)	5.1	4.3	4.2	4.35	4.35	3.5	4.3	3.55	.....
20	4.55	4.0	(1.5)	5.0	4.3	4.2	4.35	4.35	3.9	4.3	3.4	.....
21	4.5	3.9	3.35	5.0	4.3	4.2	4.35	4.35	4.05	4.3	3.4	.....
22	4.55	3.9	3.5	5.0	4.25	4.25	4.3	4.3	4.2	4.3	3.4	.....
23	4.5	3.95	3.8	4.9	4.3	4.3	4.3	4.3	4.35	(a)	3.2	.....
24	4.35	4.1	4.15	4.95	4.3	4.3	4.3	4.3	4.35	(a)	3.05	.....
25	4.25	4.3	(4.5)	4.9	4.3	4.25	4.35	4.3	4.3	(a)	3.05	.....
26	4.2	4.4	(4.8)	4.9	4.3	4.25	4.3	4.3	4.25	(a)	3.05	.....
27	4.05	4.5	(4.8)	4.9	4.3	4.25	4.3	4.3	4.25	.1	3.05	.....
28	3.95	4.5	(4.8)	4.9	4.3	4.25	4.3	4.3	4.25	.8	3.05	.....
29	3.9	.....	(4.8)	4.8	4.3	4.25	4.3	4.3	4.25	.85	3.4	.....
30	3.85	.....	4.8	4.6	4.2	4.25	4.3	4.3	3.1	1.7	3.45	.....
31	3.85	.....	4.7	.....	4.2	.....	4.25	4.3	.....	1.7	.....	.....

[a] No flow.

NOTE.—Gage heights in parentheses are estimated.

Estimated monthly discharge of Main canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	600	398	500	30,740
February	595	416	470	26,100
March	672	0	261	16,050
April	752	634	719	42,780
May	648	566	598	36,770
June	582	548	570	33,920
July	593	556	575	35,360
August	568	536	553	34,000
September	570	0	369	21,960
October	561	0	328	20,170
November	390	220	351	20,890
The period				318,700

Discharge measurements of Boundary canal near Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 3	W. V. Hardy	0.80	6.4	June 12	R. R. McCoslin	0.35	0.22
January 11	do	.98	8.6	June 18	do	1.00	11.0
January 18	do	1.00	8.9	June 26	do	.91	7.5
January 25	do		7.8	July 3	do	.93	6.4
February 2	do	.99	9.1	July 10	do	.78	4.8
February 9	do	.95	8.3	July 17	do	.77	4.2
February 17	R. R. McCoslin	.79	5.3	July 24	do	.96	6.6
February 23	do	.98	8.3	July 31	do	.87	5.3
March 1	do	1.00	10.0	August 7	do	.83	6.2
March 5	do		0	August 14	do	.78	5.7
March 8	do		0	August 21	do	.79	5.7
March 22	do	.88	7.8	August 28	do	.79	4.8
March 29	do	.80	6.2	September 4	do	.80	3.8
April 5	do	.85	8.5	September 11	do		0
April 11	do	.99	10.4	October 2	W. V. Hardy		0
April 17	do	1.00	11.7	October 6	do	.90	8.4
April 24	do	1.08	13.0	October 9	do	.87	5.3
May 1	do	.83	6.1	October 16	do	.80	5.0
May 8	do	.83	7.5	October 18	do	.25	0
May 15	do	.74	6.1	October 30	do	.85	8.0
May 22	do	.71	5.1	November 13	do	.90	8.4
May 29	do	.85	8.0	November 18	do	.95	7.0
June 5	do	.90	8.4	November 30	do	1.03	12.7

Estimated monthly discharge of Boundary canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	8.9	6.0	8.1	498
February	9.8	5.1	7.8	433
March	10.0	0	3.6	221
April	13.0	7.0	10.2	607
May	8.0	5.1	6.5	400
June	11.0	.2	7.9	471
July	6.8	4.2	5.4	332
August	6.2	4.4	5.6	344
September	6.0	0	3.8	227
October	8.0	0	4.4	271
November	12.7	7.0	9.0	536
The period				4,340

Discharge measurements of Wisteria canal near Calexico, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
January 5	W. V. Hardy	1.12	3.0	June 13	R. R. McCoslin	0.35	10.6
January 11	do	.15	0	June 19	W. V. Hardy	.57	13.5
January 18	do	.52	7.7	June 26	R. R. McCoslin	.38	10.6
January 25	do	.92	22	July 5	do	.30	9.4
February 1	do	.80	16.5	July 11	do	.96	32
February 10	do		0	July 18	do	.66	17.8
February 18	do		0	July 25	W. V. Hardy		0
February 25	R. R. McCoslin		0	August 1	do	.33	7.8
March 1	do		0	August 8	do		0
March 15	do		0	August 15	R. R. McCoslin		0
March 23	do		0	August 22	W. V. Hardy		0
March 29	do	.90	26	August 29	R. R. McCoslin		0
April 6	do	1.65	64	September 5	W. V. Hardy		0
April 12	do	1.29	47	September 12	do		0
April 18	do	1.00	33	September 26	do		0
April 25	do	.95	32	October 3	do		0
May 2	do	.50	13.1	October 11	do		0
May 9	do	.85	26	October 18	do	.60	12.8
May 16	do	.43	12.2	October 31	do	.60	14
May 23	do	.63	17.1	November 7	do	.40	12
May 30	do	.42	12.1	November 14	do		0
June 6	do	.38	11.9	November 21	do	.15	0

[a] Estimated.

Daily gage height, in feet, of Wisteria canal near Calexico, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.95	0.8	0.25	1.5	0.3	0.4	0.3	0.35	0	0.0	0.6
2	.9	.8	.2	1.2	.4	.4	.3	.05	0	.0	.6
3	1.15	.8	.2	1.7	.4	.4	.3	.05	0	.0	.6
4	1.1	1.0	.2	1.8	.4	.4	.3	.05	0	.0	.6
5	1.1	.55	.2	1.6	.7	.4	.3	.0	0	.0	.0
6	1.1	.3	.2	1.65	.7	.4	.3	.0	0	.0	.4
7	1.25	.0	.2	1.7	.8	.4	.3	.0	0	.0	.4
8	1.3	.0	.15	1.6	.8	.4	.3	.0	0	.0	.75
9	.95	.0	.15	1.5	.8	.4	.3	.0	0	.0	.75
10	.95	.0	.15	1.45	.8	.3	.3	.0	0	.0	.0
11	.15	.0	.15	1.35	.5	.3	.95	.0	0	.0	.0
12	.1	.3	.35	1.15	.45	.3	1.8	.0	0	.0	.0
13	.1	.2	.35	1.1	.45	.3	1.1	.0	0	0.6	.0
14	.0	.25	.40	.95	.45	.25	1.0	.0	0	.6	.0
15	.0	.3	.35	1.0	.45	.25	1.0	.0	0	.6	.5
16	.0	.35	.3	1.0	.45	.3	.9	.0	0	.6	.0
17	.6	.25	.3	1.0	.45	.0	.6	.0	0	.6	.0
18	.2	.1	.3	1.0	.45	.0	.65	.0	0	.6	.0
19	.65	.0	.5	.8	.75	.4	.5	.0	0	.6	.0
20	.8	.0	.5	.7	.8	.4	.5	.0	0	.6	.0
21	.8	.0	.5	.65	.8	.4	.5	.0	0	.45	.15
22	.8	.0	.5	1.0	.7	.4	.45	.0	0	.45	.35
23	.8	.0	.8	.1	.6	.4	.0	.0	0	.0	.35
24	.9	.0	.8	.9	.6	.4	.0	.0	0	.0	.1
25	.9	.0	.8	1.1	.7	.4	.0	.0	0	.0	.0
26	1.0	.2	.65	1.15	.7	.4	.0	.0	0	.0	.0
27	1.1	.2	.6	.9	.65	.4	.0	.0	0	.05	.0
28	1.0	.3	.8	.45	.65	.3	.0	.0	0	.05	.0
29	1.0	.....	.9	.4	.4	.2	.0	.0	0	.6	.0
30	1.0	.....	1.0	.35	.4	.3	.1	.0	0	.6	.0
31	.8	.....	1.15	.....	.4	.....	.35	.0	0	.6	.....

Estimated monthly discharge of Wisteria canal near Calexico, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	40	0	17.9	1,100
February	25	0	3.8	211
March	32	0	7.1	436
April	75	0	39.5	2,325
May	25	0	16.7	1,027
June	12	0	9.6	572
July	80	0	14.2	873
August	11	0	.4	25
September	0	0	.0	0
October	14	0	5.4	332
November	25	0	5.6	334
The period	.....	.....	.....	7,261

Discharge measurements of Tamarack canal near Imperial, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 25	W. V. Hardy		52	October 19	W. V. Hardy		[a] 40
June 1	R. R. McCoalin	1.70	51	October 26	do		[a] 40
June 8	W. V. Hardy	1.80	56	November 2	do		[a] 40
June 14	do	1.64	43	November 9	do		[a] 40
June 22	do	14.50	14	November 16	do		[a] 40
October 4	do		[a] 40	November 23	do		[a] 30
October 12	do		[a] 40				

[a] Estimated.

Daily gage height, in feet, of Tamarack canal near Imperial, Cal., for 1905.

Day.	June.	Day.	June.	Day.	June.	Day.	June.	Day	June.
1	1.7	7	1.8	13	1.35	19	1.65	25	1.2
2	1.68	8	1.8	14	1.65	20	1.75	26	1.05
3	1.7	9	1.8	15	1.65	21	1.5	27	1.0
4	1.55	10	1.9	16	1.6	22	1.45	28	.9
5	1.65	11	1.95	17	1.65	23	1.35	29	.9
6	1.75	12	2.05	18	1.7	24	1.2	30	.7

Estimated monthly discharge of Tamarack canal near Imperial, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June			34.3	2,041
July			(40)	2,460
August			(40)	2,460
September			(40)	2,380
October			(40)	2,460
November			(40)	2,380
The period				14,180

NOTE.—Monthly means in parenthesis estimated in the field.

Total amount of water (in acre-feet) entering the Imperial Valley through irrigation canals at international boundary, January to November, 1905, inclusive.

Canal.	January.	February.	March.	April.	May.	June.
Hemlock	263	555	658	1,149	965	839
Boundary	249	216.5	110.5	303.5	200	235.5
Wisteria	1,100	211	436	2,351	1,027	572
Tamarack	.....	.....	.....	.....	.....	2,041
New Holt, or No. 7	.....	.....	.....	.....	1,107	1,964
Main	30,744	26,102	16,048	42,783	36,770	33,917
Alamitos	1,636	633	301	2,714	1,955	2,047
Holt, or No. 5 Main	1,525	1,162	3,530	12,377	9,346	8,926
Alamo Channel	5,500	8,330	9,223	.....	.....	.....
Total	41,017	37,209	30,306	61,677	51,370	50,541

Canal.	July.	August.	September.	October.	November.	Total.
Hemlock	670	639	482	461	274	6,955
Boundary	166	172	113.5	135.5	268	2,170
Wisteria	873	25	0	332	334	7,261
Tamarack	2,460	2,460	2,380	2,460	2,380	14,181
New Holt, or No. 7	2,029	2,029	1,964	2,029	1,964	13,086
Main	35,355	34,003	21,957	20,168	20,886	318,733
Alamitos	2,084	1,470	2,428	2,201	161	17,630
Holt, or No. 5 Main	9,223	9,223	8,569	5,940	1,607	71,428
Alamo Channel	.....	.....	.....	.....	.....	23,053
Total	52,860	50,021	37,893	33,726	27,874	474,494

Total amount of water (in acre-feet) entering Imperial Valley, including canals, New River, and Alamo Channel; also amount of waste water discharging into Salton Sea and amount used for irrigation, January to November, 1905, inclusive.

Month.	Total discharge Imperial canal at headings below Yuma, Ariz.	Total discharge into Imperial Valley.	Total discharge (waste) into Salton Sea.	Total amount of water used for irrigation.
	Acre-feet.	*Acre-feet.*	*Acre-feet.*	*Acre-feet.*
January	58,100	55,590	35,356	20,234
February	227,150	92,913	77,919	14,994
March	288,990	210,896	194,548	16,348
April	233,550	223,171	182,494	40,677
May	335,420	321,239	287,869	33,370
June	573,020	622,911	587,370	35,541
July	1,104,620	1,037,724	978,244	50,480
August	609,030	597,751	564,946	32,805
September	365,360	[a] 353,360	324,869	28,491
October	468,840	[a] 456,840	435,227	21,613
November	500,000	[a] 488,000	477,977	10,023
Total	4,764,080	4,460,395	4,155,819	304,576

[a] Estimated.

Total amount of irrigated land (as per examination made in March and April, 1905)...acres... 79,591
Amount of water used per acre (in acre-feet) 3.83

LANDS IRRIGATED IN THE IMPERIAL VALLEY.

In April, 1904, an examination was made to determine the amount of lands irrigated in the valley. The gross area under irrigation at that time was 66,741 acres. A second examination was made in September of the same year by W. V. Hardy, of the Reclamation Service, and showed the total area irrigated at that time to be 31,318 acres. Another examination by Mr. Hardy in March and April, 1905, gave a total irrigated area of 79,591 acres.

The examination of area of irrigated land made in March and April, 1905, is used in computing the amount of water per acre used during 1905. It is probable that this area was greatly reduced during the summer, as areas for the raising of hay and grain were not again used after the crops were harvested until the late fall months, when they were again seeded. Large areas of alfalfa and Kaffir corn were necessarily irrigated throughout the year.

DUTY OF WATER IN THE IMPERIAL VALLEY.

During the fall of 1904 rating flumes were placed on two canals in Imperial Valley for the study of the duty of water. Two types of soil were selected for these investigations, one known as "hard soil" and classified as "Imperial loam" as shown on soil map of Bureau of Soils, United States Department of Agriculture. The other type is known as "soft soil" and classified as "Imperial sandy loam."

The location of the investigation on "Imperial loam" is at the ranch of W. W. McKim, 7 miles east of Imperial, being the west half of sec. 8, T. 15 S., R. 14 E.

The location of the investigation on "Imperial sandy loam" is on lands of the California-Mexico Land Company, 3½ miles east of Mexicala in Mexican territory and directly south of the California-Mexico boundary line in T. 17 S., R. 15 E.

Permanent flumes were constructed at the head of each of these canals and a sufficient number of measurements were made throughout the year for rating them. Self-recording registers were placed at each of these stations, and the mean daily gage height was computed from the register records.

During 1905 the Imperial Valley received a very unusual rainfall. The precipitation at Imperial was 10.06 inches for the year. At Calexico the precipitation was 9.33 inches for the year. The mean annual rainfall will probably not exceed 3 inches in normal years.

M'KIM FLUME.

This station was established on September 23, 1904. The amount of land irrigated under this flume is 380 acres. The soil is classified as "Imperial loam." The crops raised during 1905 consisted of 100 acres in barley, which was sown in October, 1904. The crop was only fair and was used for the pasturage of hogs. The balance of the area, 280 acres, had been previously planted to alfalfa, 100 acres having been sown in October, 1902, and 100 acres in October, 1903. This area in alfalfa was in fair condition at the time the station was established. The crop of 1905 was fair and used only for the pasturage of hogs. The supply of water furnished for this area was not enough for thorough irrigation. Water was taken from Alamo channel until March, 1905, and up to this time the supply was sufficient for thorough irrigation. After March, 1905, water was taken from Alamitos canal on account of flood conditions in the Alamo channel which destroyed the levee at point where the diversion was made. The water supply received from the Alamitos canal was not enough for the thorough irrigation of this area and crops suffered considerably from lack of water after March.

The rainfall for this station is taken from the United States Weather Bureau records kept at Imperial, Cal.

Monthly duty of water under McKim flume during 1905.

Month.	Acre-feet.		Rainfall in inches.
	Total.	Per acre.	
January	24.6	0.06	1.50
February	16.7	.04	6.12
March	12.3	.03	1.05
April	114.0	.30	.15
May	85.6	.22	.00
June	108.0	.28	.00
July	79.4	.21	.07
August	61.0	.16	.00
September	71.9	.19	.04
October	49.2	.13	.00
November	17.9	.05	.83
December	49.2	.13	.30
Total irrigation	689.8	1.81	10.06
Total, including rainfall	.....	2.64	.....

CALIFORNIA-MEXICO LAND AND CATTLE COMPANY'S FLUME.

This station was established November 28, 1904. It is located 3½ miles east of Mexicala. The total area irrigated under this flume is 575 acres. The soil is classified as "Imperial sandy loam." In December, 1904, the entire area was sown to barley, 75 acres were cut for hay, averaging 1¼ tons to the acre, the balance of the acreage was used for pasturage. The crop was equally as good over the entire area as that on the 75 acres which was cut for hay. In May, 1905, the entire area was sown to Kaffir corn. This crop was poor and scattering and used in the fall for pasturage. This area received an ample supply of water for the crops raised.

The rainfall for this station is taken from the United States Weather Bureau records kept at Calexico, Cal.

Monthly duty of water under California-Mexico Land and Cattle Company's flume during 1905.

Month.	Acre-feet.		Rainfall in inches.
	Total.	Per acre.	
January	67.6	0.12	1.50
February	5.6	.01	3.76
March	30.7	.05	.91
April	113.0	.20	.50
May	313.0	.55	.00
June	214.0	.37	.00
July	332.0	.58	.03
August	289.0	.50	.00
September	131.0	.23	.13
October	91.7	.16	.00
November	66.0	.11	1.96
December	104.0	.18	.54
Total irrigation	1,757.6	3.06	9.33
Total, including rainfall	.....	3.84	.....

MISCELLANEOUS MEASUREMENTS IN COLORADO RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in canals in the Colorado River drainage basin by W. D. Smith during 1905:

Miscellaneous discharge measurements made in Colorado River drainage basin in 1905.

Date.	Locality.	Width.	Area of section.	Mean velocity.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
February 15	Imperial canal in Mexico immediately below Quail River waste gate.[a]	.....	560	3.46	1,937
February 28	do	.....	556	3.28	1,821
December 17	Imperial canal in Mexico immediately below Quail River cut-off.[b]	170	1,640	3.21	5,265
December	Quail River cut-off in Mexico at point of diversion from Imperial canal.[b]	150	632	2.68	1,693

[a] Quail River waste gate is in Mexico, 12 miles below heading No. 1 of the Imperial canal. Gagings by means of boat and cable were made at this point February 15 and 28 to determine amount of water being carried to Imperial Valley by the canal.

[b] For location and significance of this gaging see general description of Imperial canal, page 21. A measurement was made by means of boat and cable.

THE GREAT BASIN DRAINAGE.

GENERAL FEATURES.

The Great Basin drainage in California is comprised within the subdrainages, Sierra Nevada and Minor Great Basin. Within the Sierra Nevada drainage is a limited area of arid country lying on the eastern slope of the Sierra Nevadas. This area includes the Susan and Owens River drainage basins. Within the Minor Great Basin drainage lies the Mohave River drainage basin. Having no outlet to the sea, the entire drainage of these basins is lost mainly through evaporation from the lakes and sinks in which the waters of these rivers collect.

SUSAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Susan River has its source in the Sierra Nevada in northeastern California, and flows eastward, discharging into Honey Lake—one of the landlocked lakes of the Great Basin—of which it is the principal feeder. A considerable area of land is irrigated from the waters of the river below the gaging station, and during the last ten or twelve years several projects have been started for irrigating other extensive areas by the storage of its waters both above and below the town of Susanville.

SUSAN RIVER NEAR SUSANVILLE, CAL.

This station was established June 3, 1900, by L. H. Taylor. It is located about three-fourths of a mile southwest of Susanville, at the electric light plant.

The channel is straight for 150 feet above and 250 feet below the station. The current is swift. There is a riffle immediately above the cable. The right bank is high and is composed of clay covered with vegetation. It is not liable to overflow. The left bank is low, liable to overflow, and covered with a sparse growth of willows. The bed of the stream is composed of gravel and cobblestones and is permanent. A short distance above the station a small irrigating ditch, known as the "Masten ditch," is taken out on the right bank.

High-water measurements are made by means of a cable and car. Measurements at low and ordinary stages are made by wading. The initial point for soundings is a post in the fence in line with the cable, 34.8 feet from the cable support on the left bank.

On December 20, 1903, the station was reestablished, and the datum of the gage was raised 2.00 feet. A gage is also placed in the flume near the head of Masten ditch. During 1905 the gage was read once each day by James Branham. Bench marks were established as follows: (1) A nail in the fence post which is used as the initial point for soundings; elevation, 11.35 feet. (2) A nail in the cable post; elevation, 9.00 feet. (3) A nail in the cottonwood tree to which the cable is attached; elevation, 10.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 51, p 408; 66, pp 115-116; 85, p 123; 100, pp 204-205; 133, p 197.
Discharge: 51, p 408; 66, p 116; 100, p 205; 133, p 197.
Discharge, monthly: 75, p 190; 133, p 198.
Gage heights: 51, p 408; 66, p 116; 85, p 124; 100. p 205; 133. p 198.
Rating table: 566, p 175.

Discharge measurements of Susan River near Susanville, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 21	J. Branham	44	92	4.79	6.60	441
May 12	do	29	48	3.27	5.40	157
June 12	do	25	31	2.32	4.70	72
June 25	do	24	18	1.66	4.20	30
July 23	do	18	10.8	1.19	3.85	12.8
August 29	do	14	8.1	0.85	3.75	6.9
September 26	do	19	13.6	1.13	4.00	15.4

Daily gage height, in feet, of Susan River near Susanville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.95	5.2	5.25	6.15	5.95	5.15	4.1	4.1	3.8	3.8	4.0	4.0
2	4.8	5.2	5.25	5.95	5.9	5.1	4.1	4.1	3.8	3.8	4.0	4.0
3	4.75	5.2	5.25	5.95	5.8	5.05	4.45	4.1	3.8	3.9	4.0	4.0
4	4.7	5.2	5.25	5.9	5.8	5.05	4.8	4.1	3.8	3.95	4.0	4.0
5	4.65	5.15	5.25	5.9	5.65	5.0	4.6	4.1	3.85	3.95	4.0	4.0
6	4.6	5.05	5.25	6.0	5.55	5.0	4.4	4.1	3.85	3.95	4.0	4.0
7	4.6	4.85	5.25	6.1	5.5	5.0	4.25	4.1	3.85	4.0	4.0	4.0
8	4.55	4.85	5.25	6.1	5.5	4.9	4.1	4.0	3.85	3.95	4.0	4.0
9	4.55	4.75	5.2	6.1	5.5	4.85	4.1	3.9	3.85	3.9	4.0	4.0
10	4.55	4.8	5.2	6.2	5.45	4.75	4.0	3.8	3.85	3.9	4.0	4.0
11	4.55	4.7	5.2	6.1	5.4	4.7	4.0	3.8	3.9	3.9	4.0	4.0
12	4.6	4.65	5.4	6.1	5.4	4.7	4.0	3.8	3.9	3.9	4.0	4.0
13	4.65	4.55	5.9	6.1	5.35	4.65	3.95	3.8	3.9	3.9	4.0	4.0
14	4.7	4.5	5.9	6.1	5.3	4.65	4.2	3.8	3.85	3.9	4.0	4.0
15	4.7	4.45	6.05	6.1	5.3	4.6	4.2	3.75	3.85	3.9	4.0	4.0
16	4.7	4.45	6.1	6.1	5.4	4.5	4.2	3.75	3.8	3.9	4.0	4.0
17	4.7	4.5	6.05	6.05	5.4	4.5	4.0	3.75	3.8	4.0	4.0	4.0
18	4.65	4.55	6.0	6.05	5.4	4.4	4.0	3.75	3.8	4.05	4.0	4.0
19	4.65	5.05	6.6	6.05	5.4	4.4	4.1	3.75	3.9	4.0	4.0	4.0
20	4.65	5.35	6.25	5.95	5.4	4.4	4.05	3.75	3.9	4.0	4.0	4.0
21	4.65	5.35	6.45	5.8	5.4	4.3	3.9	3.8	3.95	4.0	4.0	4.0
22	4.8	5.25	6.15	5.8	5.4	4.3	3.9	3.8	3.95	4.0	4.0	4.0
23	5.5	5.1	6.1	5.8	5.35	4.25	3.85	3.8	3.95	4.0	4.05	4.0
24	5.4	5.1	6.05	5.85	5.35	4.2	3.85	3.75	3.95	4.0	4.05	4.0
25	5.2	5.2	5.85	5.9	5.3	4.2	3.85	3.75	3.95	4.0	4.1	4.0
26	4.95	5.2	6.9	6.0	5.3	4.2	3.85	3.75	4.0	4.0	4.1	4.0
27	4.9	5.25	6.3	6.0	5.3	4.2	3.8	3.75	3.9	4.0	4.1	4.0
28	4.9	5.25	6.1	6.0	5.25	4.2	3.8	3.75	4.0	4.0	4.05	4.0
29	4.85	.....	6.0	6.0	5.25	4.15	3.75	3.8	3.95	4.0	4.05	4.0
30	4.8	.....	6.1	6.0	5.2	4.15	3.75	3.8	3.9	4.0	4.0	4.0
31	4.8	.....	6.0	.....	5.2	.....	4.1	3.8	.....	4.0	.....	4.0

Station rating table for Susan River near Susanville, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.75	7	4.60	59	5.50	168	6.40	356
3.80	9	4.70	68	5.60	185	6.50	382
3.90	13	4.80	77	5.70	203	6.60	410
4.00	18	4.90	87	5.80	222	6.70	440
4.10	24	5.00	98	5.90	242	6.80	470
4.20	30	5.10	110	6.00	262	6.90	500
4.30	37	5.20	123	6.10	284		
4.40	44	5.30	137	6.20	307		
4.50	51	5.40	152	6.30	331		

NOTE.—The above table is based on 11 discharge measurements made during 1904 and 1905 and is well defined.

Estimated monthly discharge of Susan River near Susanville, Cal., for 1905.

[Drainage area, 256 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	168	55	76.9	4,728	0.300	0.346
February	144	48	96.9	5,382	.379	.395
March	500	123	234	14,390	.914	1.05
April	307	222	264	15,710	1.03	1.15
May	252	123	160	9,838	.625	.721
June	116	27	61.3	3,648	.239	.267
July	77	7	23.4	1,439	.091	.105
August	24	7	12.1	744	.047	.054
September	18	9	12.3	732	.048	.054
October	21	9	15.7	965	.061	.070
November	24	18	19.0	1,131	.074	.083
December	18	18	18.0	1,107	.070	.081
The year	500	7	82.8	59,810	.323	4.38

WILLOW CREEK AT MERRILLVILLE, CAL.

This station was established June 18, 1904, by S. G. Bennett. It is located at the old bridge, 100 feet above the present wagon bridge at Merrillville.

The channel is straight above and below the bridge for 100 feet. The banks on each side are low, but not subject to overflow, and there is very little fluctuation in the discharge of the creek. The bed of the stream is composed of gravel and is not subject to much change.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank of the stream.

The gage is a staff fastened vertically to the left end of the bridge. During 1905 the gage was read once each day by R. W. Hurlbut.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 134, United States Geological Survey, pages 199–200.

Daily gage height, in feet, of Willow Creek at Merrillville, Cal., in 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.1	0.95	1.1	0.9	0.95	0.9	0.95	1.0	1.1	1.3	1.25
2	1.05	1.1	1.0	1.05	.9	.95	.9	.95	1.0	1.1	1.25	1.3
3	1.0	1.1	1.0	1.0	.95	.95	.9	.95	1.0	1.1	1.2	1.3
4	1.0	1.05	1.0	1.0	.95	.95	.9	.95	1.0	1.1	1.2	1.3
5	1.0	1.1	.95	1.0	.95	.95	.9	.95	1.0	1.1	1.2	1.3
6	1.0	1.05	.95	1.0	.95	.95	.9	.95	1.0	1.2	1.2	1.3
7	1.0	1.0	1.0	1.0	.95	.95	.9	.95	1.0	1.3	1.2	1.3
8	1.0	1.0	1.05	1.0	.95	1.0	.9	.95	1.0	1.2	1.2	1.3
9	1.0	1.0	1.0	1.0	.95	1.0	.9	1.0	1.0	1.2	1.2	1.3
10	1.0	1.0	1.0	.95	1.0	.95	.95	1.0	1.0	1.2	1.2	1.3
11	1.0	1.0	1.0	.95	1.05	.95	.95	1.0	1.0	1.2	1.2	1.3
12	1.0	1.0	1.0	.95	1.1	.95	1.05	1.0	1.0	1.2	1.2	1.3
13	1.0	1.0	1.05	1.0	1.05	.95	1.05	1.0	1.0	1.2	1.2	1.3
14	1.05	1.0	.95	1.0	1.0	.95	1.0	1.0	1.0	1.2	1.2	1.3
15	1.05	.95	1.05	1.0	.95	.95	1.0	1.0	1.0	1.2	1.2	1.3
16	1.05	1.0	1.1	1.0	.9	.95	1.0	1.0	1.0	1.2	1.2	1.3
17	1.05	1.0	1.1	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
18	1.05	1.0	1.05	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
19	1.05	1.25	1.1	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
20	1.0	1.15	1.05	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
21	1.05	1.05	1.05	1.0	.9	.95	.95	1.0	1.05	1.2	1.2	1.3
22	1.1	1.05	1.05	1.0	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
23	1.1	1.05	1.05	.9	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
24	1.1	1.0	1.0	.9	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
25	1.05	1.0	1.0	.95	.95	.95	.95	1.0	1.05	1.25	1.2	1.3
26	1.0	1.05	1.1	.95	1.0	.95	.95	1.0	1.05	1.2	1.2	1.3
27	1.0	1.0	1.1	.95	1.0	.95	.95	1.0	1.1	1.2	1.2	1.3
28	1.0	1.0	1.0	.95	1.0	.95	.95	1.0	1.15	1.2	1.25	1.3
29	1.0	.....	1.1	.9	.95	.95	.95	1.0	1.2	1.2	1.25	1.3
30	1.0	.....	1.05	.9	.95	.9	.95	1.0	1.1	1.2	1.25	1.3
31	1.0	.....	1.05	.....	.95	.....	.95	1.0	.....	1.25	.....	1.3

Station rating table for Willow Creek at Merrillville, Cal., from July 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	16	1.10	20	1.20	22	1.30	24
1.00	18						

NOTE.—The above table is based on four discharge measurements made during 1904, and is fairly well defined.

Estimated monthly discharge of Willow Creek at Merrillville, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	20	18	18.5	1,138
February	23	17	18.8	1,044
March	20	17	18.6	1,144
April	20	16	17.6	1,047
May	20	16	17.1	1,051
June	18	16	17.0	1,012
July	19	16	16.9	1,039
August	18	17	17.7	1,088
September	22	18	18.7	1,113
October	24	20	21.9	1,347
November	24	22	22.2	1,321
December	24	23	24.0	1,476
The year	24	16	19.1	13,820

WILLOW CREEK NEAR STANDISH, CAL.

This station was originally established June 4, 1900. It was reestablished January 1, 1905, and discontinued December 31 of the same year. It is located at the bridge on the road from Susanville to Hot Springs and is about 1½ miles above the junction of the creek with Susan River. It is about 4 miles west of north from Standish.

The channel is straight for 300 feet above and 250 feet below the station. The right bank is rather low and is subject to overflow at extreme high water; the left bank is high and not liable to overflow. The stream bed is sandy and liable to shift somewhat.

Discharge measurements are made from the bridge. The initial point for soundings is on the end of the bridge on the left bank.

The gage is a staff fastened vertically to the left abutment of the bridge. During 1905 the gage was read once each day by T. E. Ravenscroft

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 51, p 407; 66, p 115.
Discharge: 51, p 407.
Gage heights: 51, p 407; 66, p 115.

Discharge measurements of Willow Creek near Standish, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 24	J. Branham	57	117	0.80	6.15	94
January 29	do	57	87	.79	5.35	69
February 26	do	57	105	.79	5.75	83
April 23	do	32	21	.95	4.00	20
November 19	do	57	56	.61	4.80	34

Daily gage height, in feet, of Willow Creek near Standish, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.6	6.8	5.0	5.5	4.0	4.0	3.0	4.0	4.2	5.0	5.0	5.0
2	6.6	6.7	4.8	5.3	4.0	4.0	3.0	4.0	4.5	4.8	5.1	5.3
3	5.0	5.9	4.0	5.0	4.0	4.0	3.0	4.0	4.4	4.6	5.0	5.2
4	5.0	.....	4.0	5.0	4.0	4.0	6.0	4.0	4.4	4.3	5.0	5.0
5	4.6	5.8	4.0	4.8	4.0	4.0	5.8	4.0	4.4	4.0	5.0	5.1
6	4.6	6.0	4.4	4.5	4.0	4.0	4.8	4.0	4.4	4.0	5.1	5.0
7	4.6	6.0	4.4	4.0	4.0	4.0	4.0	4.0	4.4	4.0	5.2	5.2
8	4.6	5.8	4.4	4.0	4.0	4.2	4.0	4.0	4.4	4.2	5.0	4.1
9	4.6	5.6	4.0	4.0	4.0	4.1	4.0	4.0	4.4	4.2	5.0	4.1
10	4.6	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.1	5.2	4.4
11	4.6	5.0	4.4	4.0	4.2	4.0	4.0	4.2	4.0	4.1	5.1	4.4
12	4.7	5.0	4.0	3.8	4.2	4.0	6.0	4.0	4.0	4.0	4.6	4.4
13	4.7	5.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.4	4.3
14	4.7	5.0	4.0	4.0	4.0	4.0	5.8	4.0	6.0	4.0	4.4	4.5
15	5.8	4.6	4.4	4.0	4.0	4.0	5.0	4.0	5.8	4.0	4.4	4.1
16	5.8	4.7	4.4	4.0	4.0	4.0	5.8	4.0	5.0	4.1	4.6	4.1
17	6.0	4.7	4.4	4.0	4.0	4.0	5.8	4.0	5.0	4.5	4.8	4.3
18	6.0	4.7	4.4	4.0	4.0	4.0	5.8	4.2	5.0	4.5	4.8	4.3
19	6.4	5.1	5.0	4.0	4.0	4.0	6.0	4.2	5.0	4.5	5.0	4.3
20	6.35	6.0	5.0	4.0	4.0	4.0	6.0	4.6	5.0	4.5	5.0	4.3
21	6.0	7.8	5.2	4.0	4.1	4.0	6.0	4.5	4.8	4.5	4.8	4.0
22	7.6	7.8	5.2	4.0	4.1	4.0	5.0	4.6	4.8	4.5	4.6	5.0
23	7.8	7.0	5.0	4.0	4.0	4.0	5.0	4.2	4.8	5.0	4.6	5.0
24	6.0	6.2	4.8	4.0	4.0	4.0	4.8	4.0	4.6	5.1	4.5	5.2
25	6.0	6.0	4.6	4.0	4.0	4.0	4.1	4.0	4.5	5.2	4.4	5.0
26	5.8	6.3	5.3	4.0	4.0	6.2	4.0	4.2	5.0	5.2	4.8	5.2
27	5.6	5.0	5.0	4.0	4.0	5.0	4.0	4.2	6.0	5.1	4.8	5.3
28	5.6	5.0	5.0	4.0	3.8	4.0	4.0	4.2	5.8	5.5	5.0	5.3
29	5.7	.....	5.0	4.0	3.8	4.0	4.0	4.2	5.8	5.2	5.0	5.3
30	5.0	.....	5.0	4.0	3.8	3.6	4.0	4.3	5.0	5.0	5.0	5.3
31	5.6	.....	5.5	.....	.....	.....	4.0	4.2	.....	5.0	.....	5.3

Station rating table for Willow Creek near Standish, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.60	10	4.60	31	5.60	74	6.60	141
3.70	11	4.70	34	5.70	80	6.70	149
3.80	13	4.80	37	5.80	86	6.80	157
3.90	15	4.90	41	5.90	92	6.90	165
4.00	17	5.00	45	6.00	98	7.00	173
4.10	19	5.10	49	6.10	105	7.20	189
4.20	21	5.20	54	6.20	112	7.40	205
4.30	23	5.30	59	6.30	119	7.60	221
4.40	25	5.40	64	6.40	126	7.80	238
4.50	28	5.50	69	6.50	133		

NOTE.—The above table is based on five discharge measurements made during 1905 and is not well defined.

Estimated monthly discharge of Willow Creek near Standish, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	238	31	80.4	4,944
February [a]	238	31	89.4	4,965
March	69	17	33.5	2,060
April	69	17	22.9	1,363
May [a]	21	13	17.0	1,045
June	112	10	21.1	1,256
July	98	0	46.2	2,841
August	31	17	19.6	1,205
September	98	17	41.0	2,440
October	69	17	31.8	1,955
November	54	25	39.6	2,356
December	59	17	38.7	2,380
The year	238	0	40.1	28,810

[a] Discharge interpolated February 4 and May 31.

OWENS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Owens River has its source in the Sierra Nevadas in eastern California and flows southeast parallel with this range, finally discharging its waters into Owens Lake. This basin has a length from north to south of approximately 150 miles with a width of from 20 to 25 miles. It lies between the Sierra Nevadas on the west and the White Mountains on the east. Practically the entire flow of this river is derived from the Sierra Nevadas, as it drains the entire eastern slope of this range from Mount Lyell on the north to a point some distance below Mount Whitney on the south. The White Mountains furnish no water for this stream except in times of exceptionally heavy rain storms, which seldom occur on this range. There are numerous tributaries entering Owens River from the west which have their source in the high elevations of the Sierra Nevadas, extending from the northern to the southern limits of this basin. The topography of the portion of the Sierra Nevadas which is drained by this stream is extremely rough and precipitous, the mountains rising abruptly from Owens Valley to elevations of 13,000 to 14,000 feet. The formation is of granite, with very little soil covering and sparse timber growth. Numerous lakes and marshes are found in the upper reaches of this portion of the drainage basin. Owens River, a short distance below its source, enters a flat, swampy country known as Long Valley, where a considerable quantity of its flow is used for the irrigation of meadow lands for stock raising. This water returns to the river channel at the lower end of this valley, at which point the stream enters a deep, narrow gorge with heavy grade. As the river breaks from this canyon it enters Owens Valley, through which it flows for a distance of about 80 miles, finally discharging into Owens Lake. The gaging station at Round Valley is located at the lower end of this canyon. Below this point numerous diversions are made for the irrigation of land in Owens Valley, where the soil is extensively cultivated and large areas are used for the raising of hay and grain. This country is particularly adapted to stock raising, which is carried on extensively throughout the valley. There are numerous opportunities for the construction of storage reservoirs within this basin, both on the main stream and also on the upper reaches of its tributaries, although none have been constructed as yet. The precipitation is extremely light within the area of this basin with the exception of the high elevations of the Sierra Nevadas, where there is a heavy fall of snow. The

melting of the snow in the spring and summer months feeds the numerous tributaries of this river, insuring a continued flow throughout the year.

The gaging stations on canals taking water from Owens River may be considered as temporary. The gage rods in most instances are securely fastened to footbridges and are not liable to change. No permanent bench marks were established.

OWENS RIVER NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located at the footbridge, 700 feet above the junction of Owens River and Rock Creek.

The river at this point cuts through a lava deposit about 100 feet thick and forms a gorge, which is about 250 feet wide at the top. The channel is straight for 175 feet above and 250 feet below the station. The current is swift at all stages. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of rock and lava bowlders and is not subject to much change.

Discharge measurements are made from the single-span footbridge to which the gage is attached. The bridge is 37 feet long and has a clear span of 35 feet. The initial point for soundings is the anchor bolt of the right abutment.

The gage is a vertical rod, fastened to the concrete bridge abutment on the left bank. During 1905 the gage was read once each day by T. E. Jones. The bench mark is a bolt set in a lava bowlder 97.4 feet north of the right abutment.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 206; 134, p 200.
Discharge: 100, p 206; 134, p 201.
Discharge, monthly: 134, p 203.
Gage heights, 100, p 207; 134, p 202.
Rating table: 134, p 203.

Discharge measurements of Owens River near Round Valley, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 16	R. J. Taylor	34	73	2.52	1.97	184
February 9	do	34	76	2.30	1.95	175
April 4	J. S. Evans	34	72	2.49	2.00	179
May 22	do	34	91	3.36	2.39	306
June 27	do	34	102	3.74	2.58	382
July 25	do	34	76	2.73	2.15	207
August 15	do	34	72	2.12	1.90	154
September 8	do	34	76	2.33	2.00	177
September 27	do	34	72	2.15	1.90	155
November 2	F. R. S. Buttemer	34	72	2.28	1.80	164
November 24	do	34	75	2.40	1.85	180
December 10	do	34	70	2.16	1.73	151

Daily gage height, in feet, of Owens River near Round Valley, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.15	2.2	2.2	1.9	2.1	2.3	2.5	2.1	1.9	2.0	1.8	1.9
2	2.1	2.15	2.25	1.95	2.1	2.3	2.5	2.05	1.9	2.0	1.8	1.9
3	2.1	2.1	2.2	2.0	2.1	2.3	2.6	2.05	1.9	2.0	1.75	1.95
4	2.0	2.1	2.2	2.0	2.1	2.3	2.6	2.0	1.9	1.95	1.75	1.95
5	2.0	2.1	2.2	2.0	2.1	2.3	2.6	2.0	1.95	1.95	1.8	1.95
6	2.0	2.0	2.25	2.0	2.05	2.3	2.6	1.95	2.0	1.9	1.8	2.0
7	2.0	2.1	2.25	2.0	2.0	2.35	2.5	1.95	2.0	1.9	1.85	2.0
8	2.0	2.1	2.2	2.0	2.0	2.35	2.5	2.0	2.0	1.9	1.85	2.0
9	2.0	2.1	2.1	2.1	2.0	2.4	2.5	2.0	2.0	1.9	1.9	1.95
10	2.0	2.1	2.1	2.1	2.0	2.4	2.5	2.0	2.0	1.95	1.9	1.9
11	2.0	2.1	2.0	2.0	2.0	2.4	2.5	1.9	2.0	1.95	1.9	1.9
12	1.95	2.0	2.0	2.0	2.0	2.55	2.45	1.9	2.0	2.0	1.9	1.9
13	1.95	2.0	2.5	2.0	2.0	2.7	2.4	1.9	2.0	2.0	1.9	1.9
14	1.9	2.0	2.15	1.95	2.0	2.75	2.4	2.0	2.0	2.0	1.95	1.85
15	1.9	2.0	2.15	1.9	2.0	2.75	2.4	2.0	2.0	2.0	2.0	1.85
16	1.9	2.0	2.15	1.9	2.0	2.75	2.3	2.0	2.0	2.0	2.0	1.85
17	1.95	2.0	2.1	1.95	2.2	3.0	2.2	1.9	2.0	1.95	2.0	1.8
18	1.95	2.1	2.1	1.95	2.35	3.0	2.2	1.9	2.0	1.95	2.0	1.8
19	2.0	2.2	2.05	1.95	2.35	3.0	2.2	1.9	2.0	1.9	2.0	1.8
20	2.0	2.1	2.05	1.95	2.4	3.0	2.2	1.85	2.0	1.85	2.0	1.75
21	2.1	2.0	2.1	1.9	2.4	3.0	2.15	1.85	2.0	1.85	2.0	1.75
22	2.1	1.95	2.1	1.9	2.4	3.0	2.1	1.9	2.0	1.85	2.0	1.75
23	2.0	1.95	2.1	1.9	2.4	3.0	2.1	1.9	2.0	1.85	2.0	1.75
24	2.0	1.9	2.0	1.95	2.4	2.95	2.1	1.9	2.0	1.85	2.0	1.75
25	2.1	1.85	2.0	1.95	2.4	2.8	2.1	1.9	2.0	1.8	2.0	1.75
26	2.1	1.85	2.0	1.95	2.4	2.7	2.0	1.9	2.0	1.8	2.0	1.8
27	2.1	2.0	2.0	1.95	2.45	2.6	2.0	1.9	2.0	1.75	2.0	1.8
28	2.1	2.1	1.95	2.0	2.55	2.6	2.0	1.9	2.0	1.75	1.95	1.8
29	2.1	.....	1.9	2.05	2.5	2.55	2.0	1.9	2.0	1.75	1.9	1.8
30	2.2	.....	1.9	2.05	2.4	2.5	2.0	1.9	2.0	1.75	1.9	1.8
31	2.2	.....	1.9	.....	2.3	.....	2.0	1.9	.....	1.75	.....	1.8

Station rating table for Owens River near Round Valley, Cal., from January 1 to October 10, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	134	2.20	240	2.60	377	3.00	533
1.90	158	2.30	271	2.70	415		
2.00	184	2.40	304	2.80	453		
2.10	211	2.50	339	2.90	493		

NOTE.—The above table is based on 12 discharge measurements made during 1904-5. It is fairly well defined between gage heights 1.9 feet and 3.1 feet.

Station rating table for Owens River near Round Valley, Cal., from October 11 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	141	1.80	165	1.90	191	2.00	219

NOTE.—The above table is based on three discharge measurements made during the latter part of 1905 and is fairly well defined.

Estimated monthly discharge of Owens River near Round Valley, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	240	158	193	11,870
February	240	146	196	10,880
March	339	158	213	13,100
April	211	158	177	10,530
May	358	184	246	15,130
June	533	271	392	23,330
July	377	184	275	16,910
August	211	146	169	10,390
September	184	158	180	10,710
October	219	153	180	11,070
November	219	153	197	11,720
December	219	153	179	11,010
The year	533	146	216	156,600

ROCK CREEK NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located at the wagon bridge on the road from Long Valley to Bishop 3,500 feet above the mouth of the creek.

The channel is straight for 50 feet above and 40 feet below the footbridge. The current is swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of gravel and is not subject to much change.

Discharge measurements are made from a footbridge, which has a span of 18 feet. The initial point for soundings is on right bank of stream.

The gage is a vertical rod fastened to the left end of the bridge. During 1905 the gage was read once each day by T. E. Jones. The bench mark is a point marked on a lava rock 15 feet east of the left end of the footbridge.

Information in regard to this station is contained in the following water-supply papers of the United States Geological Survey:

Description: 100, p 207; 134, p 204.
Discharge: 100, p 207; 134, p 204.
Discharge, monthly: 134, p 207.
Gage heights: 100, p 208; 134, pp 205-206.
Rating table: 134, p 206.

Discharge measurements of Rock Creek near Round Valley, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 16	R. J. Taylor	13	16	1.76	1.52	28
February 9	do	13	12.8	1.56	1.30	20
April 4	J. S. Evans	13	12.8	1.55	1.40	19.9
April 25	do	12	11.6	1.60	1.15	18.6
May 24	do	14	19.3	2.02	1.80	39
June 27	do	14.5	23	2.22	2.00	51
July 25	do	13	12.6	1.90	1.30	24
August 15	do	12.5	11.6	1.69	1.20	19.6
September 8	do	12	11.2	1.57	1.18	18.6
September 27	do	12	11.6	1.57	1.20	18.2
November 2	F. R. S. Buttemer	13.5	14	1.50	1.35	21
November 24	do	13.5	15.3	1.50	1.46	23
December 10	do	13.5	16	1.69	1.60	27

Daily gage height, in feet, of Rock Creek near Round Valley, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	2.1	1.4	1.4	1.3	1.7	1.8	1.35	1.2	1.2	1.3	1.6
2	1.6	1.6	1.4	1.4	1.4	1.65	1.8	1.35	1.2	1.2	1.3	1.6
3	1.6	1.6	1.4	1.4	1.35	1.65	1.75	1.35	1.2	1.2	1.3	1.65
4	1.5	1.5	1.4	1.4	1.3	1.6	1.75	1.3	1.2	1.25	1.3	1.65
5	1.5	1.5	1.35	1.4	1.3	1.6	1.8	1.3	1.2	1.25	1.3	1.65
6	1.5	1.5	1.3	1.4	1.2	1.6	1.8	1.25	1.2	1.25	1.3	1.65
7	1.5	1.4	1.2	1.4	1.2	1.5	1.9	1.3	1.2	1.25	1.3	1.65
8	1.5	1.35	1.2	1.4	1.2	1.6	2.0	1.3	1.2	1.25	1.25	1.65
9	1.4	1.3	1.1	1.3	1.25	1.7	2.0	1.4	1.2	1.25	1.25	1.65
10	1.3	1.3	1.1	1.3	1.25	1.7	2.0	1.4	1.2	1.25	1.25	1.6
11	1.3	1.3	1.2	1.25	1.25	1.8	2.0	1.3	1.2	1.2	1.2	1.6
12	1.3	1.4	1.2	1.25	1.3	2.1	2.0	1.25	1.2	1.2	1.2	1.6
13	1.3	1.4	1.5	1.25	1.3	2.1	2.0	1.25	1.2	1.2	1.25	1.6
14	1.3	1.4	1.35	1.2	1.3	2.15	2.0	1.2	1.15	1.2	1.3	1.6
15	1.3	1.4	1.35	1.2	1.3	2.3	2.0	1.2	1.1	1.25	1.3	1.6
16	1.35	1.45	1.4	1.2	1.3	2.3	1.9	1.15	1.1	1.25	1.3	1.6
17	1.4	1.5	1.45	1.15	1.7	2.35	1.8	1.15	1.15	1.3	1.3	1.6
18	1.4	1.4	1.45	1.1	1.9	2.4	1.7	1.15	1.15	1.3	1.3	1.6
19	1.45	1.4	1.4	1.1	1.9	2.5	1.6	1.15	1.2	1.3	1.3	1.6
20	1.45	1.4	1.4	1.0	1.9	2.45	1.6	1.15	1.2	1.3	1.3	1.6
21	1.7	1.4	1.35	1.0	1.8	2.4	1.6	1.15	1.25	1.3	1.3	1.55
22	1.7	1.4	1.35	1.0	1.8	2.3	1.55	1.15	1.3	1.3	1.35	1.55
23	1.6	1.4	1.3	1.0	1.75	2.3	1.55	1.15	1.3	1.3	1.4	1.55
24	1.6	1.45	1.35	1.1	1.75	2.2	1.5	1.1	1.3	1.3	1.45	1.5
25	1.5	1.45	1.4	1.15	1.7	2.2	1.5	1.1	1.3	1.3	1.5	1.5
26	1.4	1.45	1.4	1.15	1.7	2.1	1.4	1.1	1.25	1.3	1.5	1.55
27	1.4	1.4	1.4	1.15	1.75	2.0	1.4	1.1	1.2	1.25	1.55	1.6
28	1.4	1.4	1.4	1.2	1.9	1.9	1.3	1.1	1.2	1.25	1.6	1.6
29	1.4	.....	1.4	1.2	1.8	1.85	1.25	1.1	1.2	1.25	1.6	1.6
30	1.3	.....	1.4	1.25	1.8	1.8	1.25	1.15	1.2	1.25	1.55	1.6
31	1.3	.....	1.4	.....	1.75	.....	1.4	1.15	.....	1.25	.....	1.55

Daily discharge, in second-feet, of Rock Creek near Round Valley, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	34	56	23	23	20	34	42	24	19	19	20	27
2	30	30	23	23	23	32	42	24	19	19	20	27
3	30	30	23	23	21	32	40	24	19	19	20	28
4	26	26	23	23	20	30	40	23	19	19	20	28
5	26	26	21	23	20	30	42	23	19	19	20	28
6	26	26	20	23	18	30	42	21	19	19	20	28
7	26	23	18	23	18	26	46	23	19	19	20	28
8	26	21	18	23	18	30	51	23	19	19	19	28
9	23	20	16	20	19	34	51	26	19	19	19	28
10	20	20	16	20	19	34	51	26	19	19	19	27
11	20	20	18	19	19	39	51	23	19	19	19	27
12	20	23	18	19	20	56	51	21	19	19	19	27
13	20	23	26	19	20	56	51	21	19	19	19	27
14	20	23	21	18	20	59	51	20	18	19	20	27
15	20	23	21	18	20	68	51	20	18	19	20	27
16	21	24	23	18	20	68	46	18	18	19	20	27
17	23	26	24	17	34	71	42	18	18	20	20	27
18	23	23	24	16	44	74	38	18	18	20	20	27
19	24	23	23	16	44	81	33	18	19	20	20	27
20	24	23	23	14	44	78	33	18	19	20	20	27
21	34	23	21	14	39	74	33	18	19	20	20	26
22	34	23	21	14	39	68	31	18	20	20	21	26
23	30	23	20	14	36	68	31	18	20	20	22	26
24	30	24	21	16	36	62	30	17	20	20	23	24
25	26	24	23	17	34	62	30	17	20	20	24	24
26	23	24	23	17	34	56	26	17	19	20	24	26
27	23	23	23	17	36	50	26	17	19	19	26	27
28	23	23	23	18	44	46	23	17	19	19	27	27
29	23	.....	23	18	39	44	21	17	19	19	27	27
30	20	.....	23	19	39	42	21	18	19	19	26	27
31	20	.....	23	.....	36	.....	26	18	.....	19	.....	26

NOTE.—Owing to shifting conditions, the daily discharge has been computed from several curves, each covering a short period of time.

Estimated monthly discharge of Rock Creek near Round Valley, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	34	20	24.8	1,525
February	56	20	24.9	1,383
March	26	16	21.5	1,322
April	23	14	18.7	1,113
May	44	18	28.8	1,771
June	81	26	51.1	3,041
July	51	21	38.5	2,367
August	26	17	20.1	1,236
September	20	18	19.0	1,131
October	20	19	19.3	1,187
November	27	19	21.1	1,256
December	28	24	26.9	1,654
The year	81	14	26.2	18,990

PINE CREEK NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located 150 feet below the wagon bridge on the road from Bishop to Long Valley and 100 feet above the mouth of the creek.

The channel is straight for about 50 feet above and 100 feet below the station. The current has a velocity of about 1 foot per second at ordinary stages. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rocky and permanent.

Discharge measurements are made by wading. The initial point for soundings is a stake on the right bank of the stream.

The gage is a vertical rod fastened in the rocks near the right bank. During 1905 the gage was read once each day by T. E. Jones. The bench mark is the one at the Rock Creek station. It is a point marked on the lava rock 15 feet east of the left end of the footbridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 208; 134, p 207.
Discharge: 100, p 209; 134, p 208.
Discharge, monthly: 134, p 210.
Gage heights: 100, p 209; 134, pp 208-209.
Rating table: 134, p 210.

Discharge measurements of Pine Creek near Round Valley, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 16	R. J. Taylor	20	15.2	0.88	1.91	13.3
February 9	do	20	15.2	.67	1.86	10.2
April 4	J. S. Evans	8	10.4	.19	1.80	2.0
April 25	do	10	8.8	.66	1.70	5.8
June 27	do	27	2.8	2.61	2.90	73
July 25	do	19	16.1	1.43	2.05	23
August 15	do	18	10.8	.67	1.80	7.2
September 8	do	17	9.2	.73	1.75	6.7
September 27	do	17	8.1	.77	1.78	6.2
November 2	F. R. S. Buttemer	17	19.7	.44	1.83	8.7
November 24	do	18	18.2	.42	1.85	7.7
December 10	do	18	18.4	.41	1.82	7.6

Daily gage height, in feet, of Pine Creek near Round Valley, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	2.2	1.8	1.8	1.8	1.9	2.9	1.8	1.7	1.8	1.8	1.85
2	2.15	2.0	1.8	1.8	1.8	1.9	2.9	1.7	1.7	1.8	1.8	1.85
3	2.1	2.0	1.8	1.8	1.75	1.9	2.85	1.7	1.7	1.8	1.8	1.9
4	1.95	1.9	1.8	1.8	1.75	1.9	2.8	1.7	1.7	1.85	1.8	1.9
5	1.95	1.9	1.8	1.8	1.75	1.95	2.8	1.7	1.7	1.85	1.85	1.9
6	1.95	1.8	1.8	1.8	1.7	1.95	2.8	1.7	1.7	1.85	1.85	1.9
7	1.9	1.8	1.8	1.75	1.7	2.05	2.9	1.7	1.7	1.85	1.85	1.9
8	1.9	1.85	1.8	1.75	1.7	2.1	2.95	1.7	1.65	1.85	1.85	1.9
9	1.9	1.85	1.8	1.75	1.7	2.45	3.0	1.8	1.6	1.85	1.8	1.9
10	1.8	1.85	1.75	1.75	1.7	2.7	3.0	1.8	1.65	1.8	1.8	1.85
11	1.8	1.85	1.75	1.8	1.75	2.6	2.9	1.75	1.65	1.8	1.8	1.85
12	1.8	1.85	1.8	1.8	1.8	2.8	2.85	1.7	1.65	1.7	1.8	1.85
13	1.75	1.85	1.8	1.8	1.8	3.3	2.8	1.7	1.65	1.75	1.8	1.8
14	1.75	1.85	1.8	1.8	1.8	3.3	2.7	1.7	1.65	1.75	1.8	1.8
15	1.75	1.85	1.8	1.8	1.75	3.3	2.6	1.7	1.6	1.8	1.8	1.8
16	1.8	1.8	1.85	1.8	1.75	3.3	2.5	1.7	1.6	1.8	1.8	1.8
17	1.8	1.8	1.85	1.8	1.75	3.25	2.4	1.7	1.65	1.8	1.8	1.8
18	1.8	1.85	1.85	1.75	1.75	3.2	2.45	1.75	1.65	1.85	1.8	1.8
19	1.8	1.85	1.8	1.75	1.75	3.2	2.5	1.75	1.7	1.85	1.8	1.8
20	1.85	1.8	1.8	1.75	1.8	3.1	2.5	1.75	1.7	1.85	1.8	1.8
21	2.0	1.8	1.8	1.75	1.9	3.1	2.1	1.75	1.75	1.85	1.8	1.8
22	2.0	1.8	1.8	1.7	1.9	3.1	1.95	1.75	1.8	1.85	1.8	1.8
23	1.9	1.8	1.8	1.7	1.9	3.0	1.95	1.75	1.8	1.85	1.8	1.8
24	1.9	1.8	1.8	1.7	2.0	2.9	2.0	1.7	1.8	1.85	1.85	1.8
25	1.9	1.85	1.8	1.7	2.0	2.9	2.0	1.7	1.8	1.85	1.85	1.8
26	1.9	1.85	1.8	1.7	2.0	2.9	2.0	1.7	1.8	1.85	1.85	1.8
27	1.9	1.8	1.8	1.7	2.0	2.9	2.05	1.7	1.8	1.8	1.85	1.8
28	1.9	1.8	1.75	1.75	1.95	2.9	2.05	1.7	1.8	1.8	1.8	1.8
29	1.9	.....	1.75	1.75	1.9	2.9	2.0	1.7	1.8	1.8	1.8	1.8
30	1.85	.....	1.75	1.75	1.8	2.9	2.0	1.7	1.8	1.8	1.8	1.8
31	1.85	.....	1.8	.....	1.85	.....	1.9	1.7	.....	1.8	.....	1.8

Station rating table for Pine Creek near Round Valley, Cal., from August 4, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.60	1	2.10	23	2.60	52	3.10	95
1.70	4	2.20	28	2.70	59	3.20	106
1.80	8	2.30	33	2.80	67	3.30	119
1.90	13	2.40	39	2.90	75		
2.00	18	2.50	45	3.00	85		

NOTE.—The above table is based on 20 discharge measurements made during 1903–1905. It is fairly well defined between gage heights 1.7 feet and 3 feet. The table has been extended beyond these limits, being based on one measurement at 3.7 feet.

Estimated monthly discharge of Pine Creek near Round Valley, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	28	6	12.7	781
February	28	8	10.6	589
March	10	6	7.9	486
April	8	4	6.5	387
May	18	4	9.0	553
June	119	13	68.1	4,052
July	85	13	47.9	2,945
August	8	4	4.8	296
September	8	1	4.6	274
October	10	4	8.7	535
November	10	8	8.5	506
December	13	8	9.5	584
The year	119	1	16.6	11,990

OWENS RIVER CANAL NEAR BISHOP, CAL.

This station was established August 5, 1903, by J. C. Clausen and R. S. Hawley. It is located at the footbridge near the quarter-section line which divides the north half of sec. 27, T 6 S., R. 32 E., of the Mount Diablo meridian.

The channel is straight for 300 feet above and 100 feet below the station. The current is sluggish. The right bank is high and rocky and will not overflow. The left bank is low and will overflow. The bed of the stream is composed of gravel and is permanent.

Discharge measurements are made from the footbridge. The initial point for soundings is on right bank of the canal.

The gage is a vertical rod nailed to the bridge. No regular observer could be obtained, but the ditch tender reads the rod when passing the station.

Information in regard to this station is contained in the following Water-Supply Paper of the United States Geological Survey:

Description: 100, pp 209-210; 134, p 211.
Discharge: 100, p 210; 134, p 211.
Discharge, monthly: 134, p 213.
Gage heights: 100, p 210; 134, p 212.
Rating table: 134, p 213.

Discharge measurements of Owens River Canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 10	R. J. Taylor	11.5	4.9	0.92	1.55	4.5
February 4	do	11	4.1	.80	1.49	3.3
April 6	J. S. Evans	14.5	16.4	1.71	2.40	28
April 24	do	15.0	22	1.91	2.77	42
May 12	do	14.5	24	1.79	2.78	43
June 1	do	14.5	21	1.76	2.62	38
July 7	do	14	16.8	1.90	2.30	32
August 4	do	14.5	23	1.87	2.75	43
September 11	do	15	19.6	1.73	2.60	34
October 24	F. R. S. Buttemer	14.5	19.3	1.45	2.38	28
November 22	do	12	5.6	.95	1.50	5.3
December 13	do	13	6.6	1.17	1.63	7.7

Daily gage height, in feet, of Owens River canal near Bishop, Cal., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	0.0	2.7	2.55	2.8	2.55	2.8
2	.....	.0	2.7	2.55	2.75	2.55	2.8
3	.....	.0	2.7	2.55	2.8	2.55	2.8
4	.....	2.4	.....	2.55	2.75	2.55	2.8
5	.....	2.7	2.65	2.55	2.8	2.55	2.8
6	.....	2.7	2.65	2.55	2.85	2.75	2.75
7	.....	2.7	2.6	2.55	2.9	2.8	2.75
8	.....	2.65	2.6	2.55	2.85	2.8	2.8
9	.....	2.7	.....	2.55	2.85	2.8	2.8
10	.....	2.5	.....	2.55	2.9	2.8	2.8
11	.....	2.7	2.65	2.55	2.9	2.75	2.7
12	.....	2.8	2.7	2.55	2.5	2.8	2.7
13	.....	2.8	2.65	2.55	2.5	2.8	2.7
14	.....	.....	2.7	2.55	2.5	2.8	2.75
15	.....	2.75	2.55	2.55	2.5	2.75	.....
16	.....	2.8	2.55	2.55	2.5	2.8	.....
17	.....	2.75	2.55	2.5	.0	2.75	.....
18	.....	2.75	2.55	2.65	.0	2.6	.....
19	.....	2.7	2.5	2.7	.0	2.6	.....
20	.....	2.75	2.5	2.7	2.6	2.6	.....
21	.....	2.75	2.5	2.65	2.6	2.6	.....
22	.....	2.7	2.55	2.65	.0	2.6	.....
23	.....	2.65	2.55	2.7	.0	2.6	.....
24	.....	2.65	2.55	2.7	2.6	2.6	.....
25	.....	2.7	2.55	2.7	2.6	2.65	.....
26	2.8	2.7	2.55	2.7	2.8	2.65	.....
27	2.8	2.75	2.55	2.7	2.85	2.7	.....
28	.....	.....	2.55	2.75	2.85	2.65	.....
29	.....	.....	2.55	2.7	2.9	2.5	.....
30	2.65	2.7	2.55	2.8	2.95	2.8	.....
31	.....	2.7	.....	2.75	2.55	.....	.....

BISHOP CREEK CANAL NEAR BISHOP, CAL.

This station was established August 5, 1903, by J. C. Clausen, assisted by R. S. Hawley. It is located at the footbridge below the waste gate near the house of A. Fitzgerald, 3½ miles northwest of Bishop, Cal.

The channel is straight for 50 feet above and 100 feet below this station. The current is swift. The right bank is high and the left bank is low. Neither bank is liable to overflow. The bed of the stream is composed of sand and gravel and is fairly permanent.

Discharge measurements are made from the footbridge. The initial point for soundings is on right bank.

The gage is a vertical rod fastened to the bridge anchor.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 210-211; 134, p 214.
Discharge: 100, p 211; 134, p 214.
Discharge, monthly: 134, p 216.
Gage heights: 100, p 211; 134, p 215.
Rating table: 134, p 216.

Discharge measurements of Bishop Creek canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 17	R. J. Taylor	15	10.1	0.84	1.40	8.5
April 6	J. S. Evans	16	30	2.07	2.80	62
April 24	do	16	47	2.23	3.81	105
May 12	do	16	49	2.20	3.95	108
June 1	do	16	50	2.08	4.00	105
July 7	do	16	44	1.75	3.70	77
August 4	do	16	51	2.39	4.10	122
September 11	do	16	44	2.20	3.85	97
October 24	F. R. S. Buttemer	16	26	1.12	1.92	29
November 22	do	13	4.6	.39	1.05	1.8
December 13	do	13	5.1	.31	1.06	1.6
December 21	do	14	15.6	.79	1.21	12.4

Daily gage height, in feet, of Bishop Creek canal near Bishop, Cal., for 1905.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept
1			9	3.9	3.5	17	3.5	2.9	25	4.0	
2			10	3.5	3.5	18	3.5	2.9	26	4.0	
3		4.0	11	3.5	3.5	19	3.5	2.9	27		
4		4.0	12	3.5	3.5	20	3.5	2.9	28		
5		4.0	13	3.5	3.5	21		2.9	29		
6	3.9	3.5	14	3.5	3.5	22	3.5	2.9	30		
7	3.9	3.5	15	3.5	3.5	23		2.9	31		
8	3.9	3.5	16	3.5	3.5	24	3.5				

FARMERS' CANAL NEAR BISHOP, CAL.

This station was established August 6, 1903, by J. C. Clausen and R. S. Hawley. It is located at the footbridge near the house of Robert Love and 3 miles north of Bishop, Cal.

The channel is straight for 300 feet above and 50 feet below the station. The current is sluggish. Both banks are low and are liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from the footbridge, to which the gage is attached. The initial point for soundings is on the footbridge, near the right bank.

The gage is a vertical rod fastened to the bridge pier.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 211-212; 134, p 216.
Discharge: 100, p 212; 134, p 217.
Discharge, monthly: 134, p 219.
Gage heights: 100, p 212; 134, pp 217-218.
Rating table: 134, p 219.

Discharge measurements of Farmers' canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 10	R. J. Taylor	13	9.0	0.69	2.20	6.2
February 4	do	13	9.4	.74	2.16	7.0
March 7	do	10	16.8	1.79	2.90	30
April 6	J. S. Evans	10.5	12.8	1.47	2.55	18.8
April 24	do	10	8.4	.64	2.30	5.4
May 12	do	10.5	12.8	1.16	2.60	14.9
June 1	do	10.5	14.6	1.37	2.60	20
July 7	do	9.5	15.4	1.56	2.75	24
August 4	do	10	9.0	.53	2.00	4.8
September 11	do	10.5	15.7	1.04	2.55	16.4
November 22	F. R. S. Buttemer	10.5	10.8	.70	2.35	7.6
December 13	do	10.5	10.8	.59	2.36	6.4

Daily gage height, in feet, of Farmers' canal near Bishop, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1								2.5
2					2.8	2.7		
3	2.2	2.15	3.0				2.6	
4		2.16		2.65				2.5
5			2.9		2.8			
6	2.2			2.55		2.7		
7			2.9				2.75	
8								2.6
9	2.2		2.9		2.6	2.75		
10	2.2							
11		2.15		1.8				2.6
12					2.6		2.7	
13					2.6	2.9		
14	2.2	2.15	3.0	1.7			2.65	
15								2.65
16					2.65	2.95		
17	2.15		2.9					
18				1.1			2.6	2.55
19					2.95			
20	2.15					2.8		
21							2.6	2.2
22				1.2				
23			2.75		2.95	2.7		
24				2.3				
25	2.15			2.3			2.6	2.65
26					2.9			2.65
27						2.7		
28	2.15		2.75	2.7			2.55	
29								
30					2.9	2.6		
31	2.15		2.75					

McNALLY CANAL NEAR BISHOP, CAL.

This station was established July 31, 1903, by J. C. Clausen and R. S. Hawley. It is located at the head of the canal, 3¾ miles north of Bishop, Cal.

The channel is straight for 50 feet below the gage. The current is swift. Both banks are high and will not overflow. The bed of the stream is rocky and permanent.

Discharge measurements are made from a footbridge. The initial point for soundings is marked on the footbridge, near the right bank.

The gage is a vertical board fastened to the headworks of the canal. No gage reader could be obtained for this station, but since the gage was installed there has been little variation in the amount of water flowing in the canal.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 213; 134, pp 219-220.
Discharge: 100, p 213; 134, p 220.
Discharge, monthly: 134, p 221.
Gage heights: 134, pp 220-221.
Rating table: 134, p 221.

Discharge measurements of McNally canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 17	R. J. Taylor	20	11.2	1.06	0.50	11.9
April 6	J. S. Evans	20	14.2	1.76	.70	25
April 24	do	21	18.2	2.09	1.00	38
May 12	do	21	21	2.05	1.05	43
June 1	do	21	25	2.23	1.10	56
July 7	do	22	32	2.69	1.30	86
August 4	do	22	32	1.66	1.50	53
September 11	do	21	23	2.17	1.10	50
November 22	F. R. S. Buttemer	21	17.5	1.14	.70	20
December 13[a]	do				.10	0

[a] Headgate shut down; no water in canal.

GEORGE COLLINS CANAL NEAR BISHOP, CAL.

This station was established August 17, 1903, by R. S. Hawley. It is located at the footbridge 3 miles east and one-half mile north of Bishop, Cal.

The channel is straight for 75 feet above and for 50 feet below the station. The current is sluggish. The right bank is low and the left bank is high. Neither bank is liable to overflow. The bed of the stream is composed of sand and is fairly permanent.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the footbridge near the right bank of the canal.

The gage is a vertical rod fastened to the bridge near the house of Arthur Wines.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 213; 134, p 222.
Discharge: 100, p 214; 134, p 222.
Discharge, monthly: 134, p 225.
Gage heights: 100, p 214; 134, pp 223-224.
Rating table: 134, p 224.

Discharge measurements of George Collins canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 2	J. S. Evans	11	10.8	1.12	1.10	12.1
May 25	do	14	13	1.13	1.35	14
June 28	do	11.5	7.3	.71	1.00	5.2
July 26	do	11.5	9.1	.65	1.00	5.9
August 9	do	11.5	8.0	.50	.60	4.0
September 5	do	12	8.4	.57	.60	4.8
September 14	do	11.6	8.0	.65	.50	5.2
October 3	do	12	8.8	1.00	.65	8.8
October 25	F. R. S. Buttemer	11	5.8	.59	.78	3.4
November 23	do	11.5	5.2	.65	.82	3.4
December 11	do	10.7	4.7	.53	.80	2.5

Daily gage height, in feet, of George Collins canal near Bishop, Cal., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1		0.9		0.8		1.0	17	1.0	1.4	1.2	0.9		
2	0.9	1.0		.8	0.8	.9	18	1.0	1.5		.9	1.2	
3		1.0	0.8		.8		19	1.0	1.4				
4	.9					.9	20	1.0		1.0		1.2	
5		1.0		.5	.8		21		1.0		.9	1.1	
6		1.0	.8			.9	22	1.0	1.0	1.0			
7	1.0	1.2	.9	.5	.9		23				.8	1.1	
8		1.5					24	1.0	.9		.8	1.1	
9	.8	1.5	1.4	.5	1.2		25		.9				
10		1.4		.5			26		1.0	.9		1.0	
11	.8	.8	1.4		1.2		27	.6			.9		
12		1.5	1.4		1.2		28	.5				1.0	
13		1.6		.8			29	.5	.8	.9	.9		
14	.8	1.6	1.4	.9			30	.6	.8		.9		
15	1.0	1.4			1.2		31						
16	1.0	1.4	1.2										

NOTE.—Water shut off October 6 to December 31.

BISHOP CREEK NEAR BISHOP, CAL.

This station was established August 10, 1903, by J. C. Clausen and R. S. Hawley. It is located at the wagon bridge on the Bishop road about 4½ miles from Bishop and about 2 miles from the point where the creek leaves the canyon. North Hillside canal, South Hillside canal, and Powers canal are taken out above the station.

The channel is straight for 100 feet above and for 50 feet below the station. The current is swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rough and rocky and is permanent.

Discharge measurements are made from the wagon bridge. The initial point for soundings is marked on the bridge near the right bank of the stream.

The gage is a vertical rod fastened in the rocks and braced to the right bank just above the wagon bridge. During 1905 the gage was read once each day by A. S. Kilpatrick. The bench mark is a large flat granite bowlder on the right bank 40 feet above the bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 214-215; 134, p 225.
Discharge: 100, p 215; 134, p 226.
Discharge, monthly: 134, p 228.
Gage heights: 100, p 215; 134, pp 226-227.
Rating table: 134, p 228.

Discharge measurements of Bishop Creek near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 11	R. J Taylor	16	22	1.18	1.40	26
February 8	do	16	24	1.25	1.55	30
March 4	do	16	23	1.35	1.55	31
April 3	J. S. Evans	16	20	2.10	1.65	42
April 18	do	16	22	1.50	1.57	33
May 5	do	16	34	2.76	2.30	94
June 21	do	19	63	6.21	3.80	391
July 10	do	18	61	5.54	3.60	338
July 27	do	17	44	4.01	2.75	178
August 10	do	16	37	3.35	2.50	124
September 7	do	16	28	2.07	2.00	58
September 22	do	16	24	1.91	1.80	46
October 25	F. R. S. Buttemer	15	25	.84	1.35	21
November 23	do	16	19.6	1.22	1.52	24
December 11	do	16	22	1.05	1.67	23
December 21	do	14	15.6	.79	1.21	12.4

Daily gage height, in feet, of Bishop Creek near Bishop, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.5	1.55	1.8	2.5	2.9	3.4	2.5	2.1	1.9	1.4	1.5
2	1.4	1.5	1.55	1.8	2.5	2.9	3.3	2.3	2,1	1.9	1.4	1.4
3	1.4	1.45	1.5	1.75	2.5	2.9	3.2	2.3	2.1	1.8	1.4	1.5
4	1.4	1.5	1.6	1.75	2.3	2.9	3.3	2.3	2.0	1.9	1.4	1.4
5	1.4	1.5	1.6	1.75	2.3	3.0	3.3	2.2	2.0	1.8	1.4	1.4
6	1.4	1.5	1.6	1.8	2.1	3.1	3.3	2.2	1.9	1.8	1.4	1.5
7	1.45	1.5	1.6	1.8	2.1	3.3	3.4	2.2	1.8	1.8	1.4	1.5
8	1.45	1.5	1.6	1.8	2.1	3.4	3.4	2.3	1.9	1.8	1.5	1.5
9	1.4	1.5	1.6	1.75	2.0	3.3	3.5	2.4	1.9	1.8	1.5	1.5
10	1.4	1.55	1.6	1.75	2.0	3.4	3.6	2.5	1.9	1.8	1.4	1.4
11	1.4	1.5	1.6	1.7	2.0	3.5	3.7	2.6	1.8	1.8	1.4	1.4
12	1.4	1.5	1.65	1.7	2.1	3.6	3.7	2.5	1.7	1.7	1.5	1.5
13	1.4	1.45	1.65	1.7	2.1	3.6	3.6	2.4	1.8	1.7	1.5	1.5
14	1.4	1.45	1.7	1.75	2.1	3.6	3.2	2.35	1.8	1.7	1.4	1.5
15	1.45	1.45	1.7	1.75	2.2	3.7	3.0	2.3	1.7	1.7	1.5	1.5
16	1.45	1.4	1.7	1.75	2.2	3.8	2.8	2.2	1.7	1.6	1.4	1.5
17	1.45	1.4	1.65	1.75	2.5	3.8	2.7	2.2	1.9	1.6	1.5	1.4
18	1.5	1.4	1.65	1.7	2.5	3.8	2.6	2.2	1.8	1.6	1.5	1.4
19	1.5	1.4	1.7	1.7	2.6	3.8	2.6	2.2	1.9	1.6	1.6	1.5
20	1.45	1.4	1.7	1.7	2.7	3.8	2.5	2.2	1.8	1.5	1.6	1.5
21	1.45	1.4	1.7	1.7	2.5	3.8	2.5	2.3	1.9	1.5	1.5	1.4
22	1.4	1.4	1.7	1.7	2.5	3.8	2.5	2.2	1.8	1.5	1.5	1.5
23	1.4	1.5	1.7	1.8	2.5	3.7	2.6	2.2	1.8	1.5	1.5	1.4
24	1.4	1.5	1.7	1.8	2.6	3.6	2.6	2.2	1.9	1.4	1.5	1.5
25	1.4	1.5	1.75	2.0	2.6	3.3	2.7	2.2	1.9	1.4	1.5	1.4
26	1.4	1.5	1.75	2.4	2.6	3.3	2.7	2.2	1.9	1.4	1.5	1.4
27	1.4	1.5	1.8	2.4	2.7	3.2	2.8	2.2	1.9	1.4	1.5	1.5
28	1.4	1.5	1.8	2.5	2.8	3.2	2.8	2.1	1.8	1.4	1.5	1.5
29	1.45	.....	1.8	2.5	2.8	3.2	2.7	2.1	1.8	1.4	1.6	1.6
30	1.45	.....	1.8	2.5	2.8	3.3	2.6	2.1	1.7	1.4	1.6	1.7
31	1.45	.....	1.8	.....	2.8	.....	2.5	2.0	.....	1.4	.....	1.6

NOTE.—Gage heights interpolated February 17-19.

Station rating table for Bishop Creek near Bishop, Cal., from January 1 to December 11, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.40	21	2.10	74	2.80	170	3.50	314
1.50	27	2.20	84	2.90	188	3.60	339
1.60	33	2.30	95	3.00	206	3.70	365
1.70	40	2.40	108	3.10	225	3.80	391
1.80	48	2.50	122	3.20	245		
1.90	56	2.60	137	3.30	267		
2.00	65	2.70	153	3.40	290		

NOTE,—The above table is based on 14 discharge measurements made during 1905 and some older measurements. It is not very well defined. This table does not apply later than December 11, as conditions were changed at the station.

Estimated monthly discharge of Bishop Creek near Bishop, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	27	21	22.5	1,384
February	30	21	25.2	1,400
March	48	27	38.2	2,349
April	122	40	56.6	3,368
May	170	65	113	6,948
June	391	188	299	17,790
July	365	122	215	13,220
August	137	65	92.1	5,663
September	74	40	53.6	3,189
October	56	21	36.1	2,220
November	33	21	25.6	1,523
December 1-11	27	21	24.3	530
The period				59,580

RAWSON CANAL NEAR BISHOP, CAL.

This station was established August 7, 1903, by R. S. Hawley. It is located at the county bridge 2½ miles east of Bishop, Cal.

The channel is straight for 100 feet above and below the station and the current is swift. The right bank is high and the left bank is low. Neither bank is liable to overflow. The bed of the stream is composed of gravel and is permanent.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the bridge near the right bank of the canal.

The gage is a vertical rod fastened to the bridge. During 1905 the gage was read by W. P. Parker.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 215-216; 134, p 229.
Discharge: 100, p 216; 134, p 229.
Discharge, monthly: 134, p 231.
Gage heights: 100, p 216; 134, pp 230-231.
Rating table: 134, p 231.

Discharge measurements of Rawson canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sc.*	*Feet.*	*Sec.-ft.*
March 14	R. J. Taylor	17	13.2	1.67	1.75	22
April 1	J. S. Evans	17	13.3	1.95	1.85	26
April 17	do	17	10.6	1.59	1.60	16.9
May 2	do	17	16.3	1.72	1.90	28
May 25	do	17	17.4	1.55	1.90	27
June 28	do	17	14.8	1.22	1.70	18.1
July 26	do	14	5.4	.39	1.30	2.1
August 9	do	17	14.6	1.00	1.55	14.6
September 5	do	16	9.8	.72	1.45	7.0
September 14	do	17	10.1	1.05	1.50	10.6
October 3	do	17	15.2	1.17	1.90	17.8
October 25	F. R. S. Buttemer	7	4.2	.29	1.05	1.2
November 23	do	6	1.6	.69	1.15	1.1
December 11	do	7	4.2	.31	1.08	1.3

Daily gage height, in feet, of Rawson canal near Bishop, Cal., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1.8	1.7	1.8	0.8	0.9	1.3	1.8
2	.....	.....	1.7	1.8	.9	.9	.....	1.8
3	.....	1.8	1.7	1.8	.9	.8	1.3	1.8
4	.....	1.8	1.9	1.8	.9	.8	1.5	1.8
5	.....	1.8	.....	1.7	.9	.8	1.5	1.8
6	1.4	.....	1.9	1.9	.8	.8	1.5	1.8
7	1.4	1.7	1.9	1.9	.8	.8	1.7	1.6
8	1.5	1.7	1.8	1.9	.8	.8	1.7	1.4
9	1.5	.....	1.8	1.8	.8	.8	1.7	1.4
10	1.6	1.7	1.8	1.8	.8	.8	1.7	1.4
11	1.6	1.7	1.8	1.9	.7	.8	1.7	1.4
12	1.6	1.7	1.8	1.8	.7	.8	1.7	1.6
13	1.8	.....	1.8	1.8	.7	.9	1.6	1.6
14	1.8	1.7	1.8	1.7	.8	.9	1.6	.....
15	.....	1.6	1.9	1.0	.8	.0	1.6	.....
16	.....	1.6	1.9	.9	.8	.....	1.6	.....
17	.....	1.6	1.9	1.4	.8	.9	1.6	.....
18	.....	1.6	1.9	1.4	.8	.9	1.6	.....
19	.....	1.6	1.9	.....	.8	.9	1.6	.....
20	.....	1.7	1.9	.....	.8	.....	1.6	.....
21	.....	1.7	1.8	.....	.8	.7	1.7	.....
22	.....	1.7	1.9	.6	.7	.7	1.7	.....
23	.....	.....	1.9	.8	.7	.7	.....	.....
24	.....	1.7	1.8	.9	.7	.7	1.7	.....
25	.....	1.7	1.8	.9	.7	.7	1.7	.....
26	.....	1.7	1.8	.9	.....	1.3	1.7	.....
27	.....	1.7	1.8	.8	.....	1.3	1.7	.....
28	.....	1.7	1.8	.8	.....	1.3	1.7	.....
29	.....	1.7	1.7	.8	.9	.....	1.7	.....
30	1.8	1.7	1.7	.8	.9	1.3	.....	.....
31	1.8	.....	1.7	.....	.9	.....	.....	.....

NOTE.—Water shut off January 1 to March 5 and October 14 to December 31.

A. O. COLLINS CANAL NEAR BISHOP, CAL.

This station was established August 7, 1903, by R. S. Hawley. It is located at the county bridge, 3 miles east of Bishop, Cal.

The channel is straight for 100 feet above and 50 feet below the station. The current is sluggish. Both banks are high and are not liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the foot log near the right bank of the canal.

The gage is a vertical rod fastened to the right bank just above the bridge, from which discharge measurements are made. During 1905 the gage was read by W. P. Parker.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 216-217; 134, p 232.
Discharge: 100, p 217; 134, p 232.
Discharge, monthly: 134, p 235.
Gage heights: 100, p 217; 134, pp 233-234
Rating table: 134, p 234.

Discharge measurements of A. O. Collins canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 14	R. J. Taylor	11	12.5	2.00	2.90	25
April 1	J. S. Evans	8	2.8	.75	2.00	2.1
May 2	do	11.5	12.8	1.95	3.00	25
June 28	do	10	10.8	1.70	2.75	18.4
July 26	do	10	12.8	1.44	2.90	18.4
August 9	do	10	8.8	1.59	2.65	14.0
September 5	do	10	6.0	1.22	2.38	7.3
September 14	do	10	5.4	1.20	2.33	6.5
October 3	do	10	10.4	1.47	2.80	15.3
October 25	F. R. S. Buttemer					0
November 23	do	10.5	7.0	.70	2.25	4.9
December 11	do	10	3.8	.45	1.92	1.7

Daily gage height, in feet, of A. O. Collins canal near Bishop, Cal., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1				2.6	1.8	2.5	2.5	2.4	2.5
2				2.6	1.8	2.5	2.0		2.5
3				2,8	1.6	2.7		2.6	2.5
4				3.0	1.9	2.7		2.6	2.2
5					1.9	2.8		2.6	2.2
6				3.0	1.7	2.8		2.6	2.2
7				3.0	1.7	2.8		2.3	2.2
8				2.4	1.8	2.9		2.0	2.2
9				2.3	1.9	2.9		2.0	2.2
10		2.4		2.3	1.9	3.0	2.3	2.0	2.2
11		2.4		2.3	1.9	3.0	2.3	2.0	2.3
12		2.4		2.3	1.9	3.0	2.3	2.0	2.3
13		2.8		2.3	2.2	3.0	2.3	2.3	2.3
14		2.8		2.3	2.3	2.9	2.3	2.3	
15		2.8		2.3	2.3	2.9		2.3	
16		2.8			2.4	2.9		2.3	
17		2.8				2.9	2.3	2.9	
18		2.8				2.9	2.1	2.9	
19		2.8	2.6			2.8	2.1	2.9	
20		2.8	2.6			2.8		2.9	
21		2.8	2.6			2.8	2.1	2.9	
22	2.3	3.0	2.6		2.3	2.8	2.1	2.7	
23		3.0			2.3	2.7	2.0		
24		3.0	2.5		2.3	2.7	2.0	2.7	
25		2.7	2.5		2.6	2.7	2.0	2.7	
26	2.3		2.5		2.6	2.7	2.0	2.7	
27			2.5		2.6		2.0	2.5	
28			2.6		2.6		2.4	2.5	
29			2.6		2.6	2.7		2.5	
30			2.6		2.5	2.7	2.4		
31				1.7		2.5			

NOTE.—No flow on days of missing gage heights.

DELL CANAL NEAR BISHOP, CAL.

This station was established August 24, 1903, by R. S. Hawley. It is located at a flume 3 miles from the head gate at a point where the canal crosses a slough in Sanders's field.

The channel is straight for 150 feet above and for 200 feet below the station. The current is sluggish at all times.

Discharge measurements are made from a bridge across the flume. The initial point for soundings is the edge of the flume at the right side.

The gage is a vertical rod fastened to the flume.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 217-218; 134, p 235.
Discharge: 100, p 218; 134, pp 235-236.
Discharge, monthly: 134, p 237.
Gage heights: 100, p 218; 134, pp 236-237.

Discharge measurements of Dell canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 10	R. J. Taylor	7.5	10.1	2.38	1.40	24
April 14	J. S. Evans	7.6	7.6	2.16	1.20	16.4
April 28	do	7.6	11.8	1.95	1.35	23
May 11	do	7.6	12.5	2.08	1.48	26
June 26	do	7.6	11.4	1.93	1.60	22
July 6	do	7.6	12.2	1.97	1.70	24
August 2	do	7.6	9.1	1.89	1.30	17.2
September 6	do	7.6	9.1	1.85	1.31	16.8
September 28	do	7.6	6.8	1.70	1.12	11.6
October 30	F. R. S. Buttemer	7.5	9.0	1.52	1.22	13.7
November 18	do	7.5	9.7	1.71	1.35	16.6
December 5	do	7.3	4.4	.68	.62	3.0

Daily gage height, in feet, of Dell canal near Bishop, Cal., for 1905.

Day.	Feb.	Mar.	Apr.	Nov.	Dec.	Day.	Feb.	Mar.	Apr.	Nov.	Dec.
1			1.3			17					
2		1.4			0.9	18		1.4		1.35	
3						19					
4		1.4			.8	20		1.4		1.3	
5						21					
6		1.4			.6	22		1.4		1.3	
7						23					
8		1.4			.6	24		1.2		1.3	
9						25					
10		1.4			.6	26	1.4	1.2		1.3	
11						27					
12		1.4			.8	28	1.4	1.2		1.4	
13						29					
14		1.4			.8	30		1.2		1.35	
15						31					
16		1.4			.8						

BIG PINE AND OWENS RIVER CANAL NEAR BISHOP, CAL.

This station was established by J. C. Clausen and R. S. Hawley, August 4, 1903. It is located at a footbridge near the house of William Oliver, the observer. It is 7½ miles south and 3 miles east of Bishop, Cal.

The channel is straight for 600 feet above and 300 feet below the station. The current is sluggish. Both banks are high and are not liable to overflow. The bed of the stream is sandy and somewhat shifting.

Discharge measurements are made from the footbridge. The initial point for soundings is marked on the footbridge near the right bank of the canal.

The gage is a vertical rod securely nailed to the footbridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 218–219; 134, p 238.
Discharge: 100, p 219; 134, p 238.
Discharge, monthly: 134, p 240.
Gage heights: 100, p 219; 134, pp 238–239.
Rating table: 134, p 240.

Discharge measurements of Big Pine and Owens River canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 25	R. J. Taylor	22	11.3	0.84	1.30	9.0
February 13	do	22	9.5	.70	1.15	6.7
April 28	J. S. Evans	21	12.6	.85	1.30	10.7
May 11	do	22	16	1.11	1.50	17.7
June 26	do	22	27	1.11	1.90	30
July 6	do	22	18.8	1.05	1.75	19.6
August 2	do	22	10.8	.58	1.20	6.3
September 6	do	16	10.0	.59	1.17	5.9
September 28	do	14	7.2	.36	1.10	2.6
October 30	F. R. S. Buttemer	22	41	1.00	2.53	41
November 18	do	22	17.6	.85	1.42	15
December 5	do	22	18.2	.89	1.45	16.2

Daily gage height, in feet, of Big Pine and Owens River canal near Bishop, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.4	1.2	1.15	1.4	2.0	1.8	1.1	1.2	1.4	2.55	1.4
2	1.2	1.4	1.2	1.15	1.8	1.85	1.8	1.1	1.1	1.3	2.55	1.45
3	1.2	1.4	1.15	1.15	1.8	1.8	1.8	1.1	1.2	1.4	2.55	1.5
4	1.2	1.3	1.15	1.15	1.9	1.8	1.8	1.1	1.2	1.5	2.5	1.5
5	1.2	1.25	1.15	1.15	1.7	1.8	1.8	1.0	1.2	1.65	2.5	1.45
6	1.25	1.25	1.15	1.15	1.7	1.7	1.7	1.1	1.2	1.9	2.25	1.45
7	1.3	1.25	1.15	1.1	1.5	1.7	1.7	1.1	1.2	1.9	2.3	1.45
8	1.3	1.15	1.15	1.1	1.5	1.7	2.0	1.1	1.2	1.8	2.3	1.45
9	1.25	1.15	1.1	(a)	1.6	1.95	2.05	1.2	1.2	2.0	2.3	1.45
10	1.25	1,2	1.1	(a)	1.55	2.15	2.2	1.2	1.2	2.1	2.55	1.4
11	1.25	1.2	1.1	(a)	1.55	2.1	2.25	1.2	1.3	2.15	1.2	1.4
12	1.25	1.2	1.15	(a)	1.5	2.3	2.35	1.2	1.3	2.2	1.2	1.4
13	1.25	1.2	1.5	(a)	1.5	2.45	2.4	1.2	1.2	2.2	1.2	1.4
14	1.25	1.15	1.75	1.35	1.5	2.65	2.4	1.2	1.2	2.1	1.2	1.4
15	1.3	1.15	1.55	1.4	1.5	2.7	2.25	1.2	1.3	2.15	1.2	1.4
16	1.4	1.2	1.55	1.35	1.5	2.8	2.1	1.2	1.3	2.15	1.2	1.4
17	1.4	1.2	1.4	1.35	1.55	1.8	2.05	1.2	1.3	2.3	1.3	1.4
18	1.35	1.2	1.4	1.45	1.6	1.8	1.8	1.2	1.3	2.3	1.4	1.4
19	1.35	1.2	1.35	1.3	1.8	1.85	1.7	1.1	1.1	2.35	1.4	1.4
20	1.4	1.2	1.35	1.3	2.1	1.7	1.6	1.1	1.15	2.35	1.35	1.4
21	1.4	1.15	1.35	1.15	2.15	1.65	2.0	1.0	1.15	2.35	1.3	1.35
22	1.35	1.15	1.35	1.15	2.25	1.7	1.9	1.0	1.1	2.35	1.25	1.35
23	1.35	1.15	1.1	1.1	2.2	1.8	2.0	1.5	1.1	2.35	1.25	1.35
24	1.35	1.25	1.1	1.1	2.25	2.2	1.6	1.6	1.1	2.35	1.25	1.3
25	1.35	1.25	1.1	1.1	2.0	2.2	1.4	1.5	1.2	2.35	1.3	1.3
26	1.35	1.25	1.1	1.45	1.8	1.9	1.3	1.4	1.2	2.35	1.3	1.4
27	1.3	1.3	1.2	1.4	2.25	1.8	1.3	1.4	1.15	2.35	1.4	1.4
28	1.3	1.2	1.2	1.4	2.25	1.6	1.2	1.4	1.15	2.45	1.4	1.4
29	1.3	.....	1.2	1.4	2.45	1.5	1.1	1.2	1.15	2.45	1.4	1.3
30	1.25	.....	1.1	1.4	2.4	1.8	1.1	1.3	1.15	2.5	1.4	1.3
31	1.25	.....	1.1	.....	2.1	.....	1.1	1.3	.....	2.55	.....	1.3

a Water shut off April 9–13.

SANGER CANAL AT ALVORD, CAL.

This station was established August 4, 1903, by J. C. Clausen and R. S. Hawley. It is located at the county road bridge, one-fourth mile east of the Southern Pacific Railroad station at Alvord, Cal.

The channel is straight for 300 feet above and for 100 feet below the station. The current is sluggish. Both banks are low and liable to overflow. The bed of the stream is shifting.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the bridge near the left bank of the canal.

The gage is a vertical rod fastened to the bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 219–220; 134, pp 240–241.
Discharge: 100, p 220; 134, p 241.
Gage heights: 100, p 220; 134, pp 241–242.

Discharge measurements of Sanger canal at Alvord, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 7	R. J. Taylor	16	23	0.59	2.38	13.6
February 18	do	16	22	.63	2.32	13.9
April 14	J. S. Evans	16	26	.38	2.80	9.9
April 26	do	16	29	.30	2.88	8.8
May 19	do	16	32	.18	3.05	5.6
June 9	do	16	29	.16	2.80	4.7
August 17	do	16	18	.22	2.10	4.0
September 13	do	16	16	.18	2.10	2.8
October 30	F. R. S. Buttemer	16	30	.44	2.82	13.2
November 18	do	16	26	.39	2.60	10.2

Daily gage height, in feet, of Sanger canal at Alvord, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	2.2		1.2	2.7	2.9	17	1.9		2.2	2.8	
2		1.7	1.2	2.7	2.9	18		1.3	2.2	2.8	3.5
3	2.1					19	1.8	1.3	2.2		
4		1.6	1.2	2.8	2.9	20				2.8	3.5
5	2.1	1.6	1.2			21	1.8	1.3	2.4		
6				2.8	3.0	22	1.8			2.8	
7	2.1	1.5	1.2		3.0	23		1.3	2.4		
8	2.1			2.9		24	1.8			2.8	
9		1.5	1.8	2.9	3.1	25		1.3	2.4		
10	2.0					26	1.8	1.3	2.4	2.8	
11		1.4	2.0	2.9	3.3	27					
12	2.0	1.4	2.1			28	1.7	1.2	2.6	2.8	
13				2.9	3.4	29	1.7			2.8	
14	1.9	1.3	2.1		3.4	30			2.7	2.8	
15	1.9			2.8		31	1.7		2.7		
16		1.3	2.2	2.8	3.4						

EAST SIDE CANAL NEAR CITRUS, CAL.

This station was established August 27, 1903, by R. S. Hawley. It is located at the head gate of the canal.

At low stages the meter measurements are made by wading at a point below the head gate. High-stage measurements are made from Southern Pacific Railroad bridge, one-half mile below head gate.

The gage is a vertical rod fastened to the head gate at which discharge measurements are made. During 1905 the gage was read by J. Vaughn.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 220; 134, pp 242-243.
Discharge: 100, p 221; 134, p 243.
Discharge, monthly: 134, p 245.
Gage heights: 100, p 221; 134, pp 243-244.
Rating table: 134, p 245.

Discharge measurements of East Side canal near Citrus, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 2	R. J. Taylor	20	21	1.48	2.30	31
May 29	J. S. Evans	21	28	1.14	2.60	32
August 23	do	24	35	.63	3.10	22
September 20	do	21	28	.50	3.00	14
November 8	F. R. S. Buttemer	18	27	.66	2.63	18
December 3	do	11	3.7	1.30	1.90	4.8

Daily gage height, in feet, of East Side canal near Citrus, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					2.5				3.0			2.0
2						2.4				3.1		
3		2.3	2.3	2.5			3.4				3.0	
4								3.3	3.1			2.1
5					2.5	2.6						
6	2.3	2.0	2.3							3.1	2.9	
7				2.5			3.3	3.3				
8					2.5				3.1			2.1
9	2.4					3.0				3.1		
10		2.0	2.4	2.5			3.3				2.9	
11								3.1	3.1			2.1
12					2.5	3.2						
13	2.2	2.0	2.6							3.1	2.8	
14				2.6			3.3	3.1				
15					2.6				3.1			2.1
16	2.3					3.2				3.1		
17		2.1	2.5	2.6			3.2				2.8	
18								3.1	3.1			2.1
19					2.6	3.2						
20	2.3	2.2	2.1							3.2	2.7	
21				2.6			3.1	3.1				
22					2.5				3.1			2.1
23	2.2					3.2				3.2		
24		2.2	2.2	2.6			3.2				2.6	
25								3.2	3.0			2.0
26					2.5	3.2						
27	2.3	2.2	2.5							3.2	2.6	
28				2.5			3.2	3.1				
29					2.6				3.1			1.9
30	2.3					2.3				3.0		
31			2.5				3.2					

STEVENS CANAL NEAR CITRUS, CAL.

This station was established August 27, 1903, by R. S. Hawley. It is located at the waste gate of the canal, 3½ miles north of Citrus, Cal.

The channel is straight for 300 feet above and 200 feet below the station. The current is sluggish. Both banks are high and are not liable to overflow. The bed of the stream is composed of gravel and earth and is fairly permanent.

Discharge measurements are made by wading. The initial point for soundings is on the right bank of the canal.

The gage is a vertical rod fastened to the waste gate. During 1905 the gage was read by J. Vaughn.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 221; 134, p 245.
Discharge: 100, p 222; 134, p 246.
Discharge, monthly: 134, p 248.
Gage heights: 100, p 222; 134, pp 246-247
Rating table: 134, pp 247-248.

Discharge measurements of Stevens canal near Citrus, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 29	J. S. Evans	12	29	1.28	2.70	37
August 23	do	12	26	.71	2.50	18.5
September 20	do	12	25	.92	2.55	23
November 8	F. R. S. Buttemer	13	11.6	.92	1.80	10.7
December 3	do	11	9.6	.76	1.65	7.3

Daily gage height, in feet, of Stevens canal near Citrus, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.6	1.9	.....	2.1	.....	.....	.....	2.3	.....	2.8	2.5
2	1.6	.....	.....	.....	.....	2.8	.....	2.5	.....	2.6	.....	.....
3	.....	1.6	1.8	1.5	2.2	.....	2.8	.....	.....	.....	2.8	.....
4	1.6	.....	.....	.....	.....	.....	.....	2.5	2.4	2.6	.....	1.8
5	.....	.....	.....	1.5	2.3	2.8	2.9	.....	.....	.....	.....	.....
6	1.5	1.5	1.9	.....	.....	.....	.....	.....	2.4	2.6	2.8	1.8
7	.....	.....	.....	1.5	.....	2.8	2.8	2.5	.....	.....	.....	.....
8	.....	1.5	2.3	.....	2.2	.....	.....	.....	2.4	.....	2.8	1.8
9	1.5	.....	.....	.....	.....	2.8	.....	2.5	.....	2.7	.....	.....
10	.....	1.5	2.3	1.5	2.2	.....	2.9	.....	.....	.....	2.8	.....
11	1.5	.....	.....	.....	.....	.....	.....	2.5	2.5	2.7	.....	1.7
12	.....	.....	.....	1.6	2.2	2.8	2.9	.....	.....	.....	.....	.....
13	1.5	1.5	2.4	.....	.....	.....	.....	.....	2.5	2.7	2.8	1.7
14	.....	.....	.....	1.6	.....	2.8	2.9	2.7	.....	.....	.....	.....
15	.....	1.5	2.5	.....	2.2	.....	.....	.....	2.5	.....	2.8	1.7
16	1.5	.....	.....	.....	.....	2.9	.....	2.7	.....	2.8	.....	.....
17	.....	1.5	2.6	1.6	2.2	.....	2.8	.....	.....	.....	2.8	.....
18	1.6	.....	.....	.....	.....	.....	.....	2.6	2.6	2.8	.....	1.7
19	.....	.....	.....	1.6	2.2	2.9	2.7	.....	.....	.....	.....	.....
20	1.5	1.6	2.4	.....	.....	.....	.....	.....	2.6	2.8	2.6	1.7
21	.....	.....	.....	1.6	.....	2.9	2.7	2.5	.....	.....	.....	.....
22	.....	1.6	2.0	.....	2.5	.....	.....	.....	2.6	.....	2.6	1.7
23	1.5	.....	.....	.....	.....	2.9	.....	2.5	.....	2.9	.....	.....
24	.....	2.0	1.5	1.6	.....	.....	2.7	.....	.....	.....	2.5	.....
25	1.5	.....	.....	.....	.....	.....	.....	2.5	2.6	2.9	.....	1.7
26	.....	.....	.....	1.5	2.6	2.9	2.8	.....	.....	.....	.....	.....
27	1.5	1.9	1.5	.....	.....	.....	.....	.....	2.6	2.9	2.5	1.7
28	.....	.....	.....	2.1	.....	2.7	2.8	2.4	.....	.....	.....	.....
29	.....	.....	1.5	.....	2.7	.....	.....	.....	2.5	.....	2.5	1.7
30	1.5	.....	.....	.....	.....	2.8	.....	2.4	.....	2.8	.....	.....
31	.....	.....	1.5	.....	2.8	.....	2.5	.....	.....	.....	.....	.....

OWENS RIVER NEAR CITRUS, CAL.

This station was established October 30, 1903, by R. S. Hawley. It is located at the county bridge 4 miles east of Independence, Cal., and 1 mile from the Southern Pacific Railroad station at Citrus, Cal. The station at this point shows the amount of waste water which is discharged into Owens Lake.

The channel is straight for 200 feet above and for 300 feet below the station. The current has a mean velocity of about 2 feet per second at ordinary stages. Both banks are high and are not liable to overflow. The bed of the stream is sandy and is liable to shift.

Discharge measurements are made by means of a cable and car located about 1,500 feet above the bridge. The cable has a span of 120 feet.

The gage is a vertical rod nailed to a pile on the upstream side of the middle pier of the bridge. During 1905 the gage was read by Milton Levy. The bench mark is a copper tack in the floor beam directly over the gage rod; elevation, 13.50 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 222; 134, p 248.
Discharge: 100, p 223; 134, p 249.
Discharge, monthly: 134, p 251.
Gage heights: 100, p 223; 134, pp 249-250.
Rating table: 134, p. 251.

Discharge measurements of Owens River near Citrus, Cal., in 1905.

Date	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 2	R. J. Taylor	73	176	2.21	6.00	389
May 29	J. S. Evans	47	40	1.52	3.60	61
July 21	do	68	68	1.84	4.30	125
August 23	do	24	15.2	.80	3.00	12.1
September 20	do	25	20	1.05	3.15	12
November 8	F. R. S. Buttemer	71	91	1.98	4.65	180
December 3	do	73	131	2.21	5.20	290
December 15	do	72	128	2.20	5.30	282

Daily gage height, in feet, of Owens River near Citrus, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			5.85				5.6			3.5	4.6	5.15
2		6.0					5.35			3.45	4.65	5.2
3		6.8					5.0			3.45	4.7	5.3
4		6.8	5.8				5.0			3.5	4.75	5.35
5							5.0			3.55	4.8	5.35
6	5.7	6.9	5.8	5.0			5.0			3.5	4.8	5.4
7	5.65	6.8					5.0			3.5	4.8	5.4
8	5.65	6.85	5.75				5.5			3.6	4.85	5.35
9		6.8	5.45				5.1			3.8	4.85	5.4
10		6.85	5.4				5.1			3.85	4.9	5.4
11		6.9	5.45				5.2			3.9	4.9	5.4
12		6.9	5.4				5.25			3.9	4.9	5.35
13			5.7				5.3			4.0	4.9	5.4
14	5.7	7.1		4.5			5.3			4.1	4.95	5.4
15	5.8	7.15	5.8				5.3			4.15	4.95	5.4
16		7.2	6.3				5.3			4.15	5.0	5.4
17		7.2	6.4				5.0		3.1	4.2	5.0	5.5
18							4.8		3.1	4.25	5.0	5.45
19	5.8						4.75		3.2	4.3	5.0	5.4
20	5.9						4.6		3.3	4.3	5.0	5.5
21	5.85	5.8					4.4		3.3	4.4	5.0	5.4
22		5.8					4.1		3.3	4.4	5.0	5.45
23	6.0	5.8				6.0	3.5		3.3	4.5	5.0	5.5
24						6.1	3.2		3.2	4.5	5.0	5.5
25						6.3	3.0		3.25	4.4	5.0	5.45
26	6.0	5.8				6.4	2.8		3.3	4.45	5.0	5.45
27	6.0					6.35	2.75		3.35	4.5	5.0	5.4
28						6.0	2.6		3.4	4.5	5.0	5.5
29						5.6	2.5		3.4	4.5	5.0	5.4
30	5.8					5.6			3.45	4.55	5.0	5.45
31										4.6		5.45

Station rating table for Owens River near Citrus, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	0	3.70	63	4.90	217	6.10	440
2.60	1	3.80	73	5.00	233	6.20	462
2.70	3	3.90	83	5.10	249	6.30	485
2.80	5	4.00	94	5.20	266	6.40	508
2.90	8	4.10	105	5.30	283	6.50	532
3.00	12	4.20	117	5.40	301	6.60	556
3.10	18	4.30	130	5.50	319	6.70	581
3.20	24	4.40	144	5.60	337	6.80	607
3.30	31	4.50	158	5.70	356	6.90	634
3.40	38	4.60	172	5.80	376	7.00	662
3.50	46	4.70	187	5.90	397	7.10	690
3.60	54	4.80	202	6.00	418	7.20	720

NOTE.—The above table is based on 11 discharge measurements made during 1904–5. It is fairly well defined between gage heights 3 feet and 7 feet.

Estimated monthly discharge of Owens River near Citrus, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January [a]	418	283	369	22,690
February [a]	720	376	540	29,990
March 1–17 [a]	508	301	372	12,540
June 23–30	508	337	430	6,823
July	337	0	175	10,760
September 17–30	42	18	29.9	830
October	172	42	107	6,579
November	233	172	219	13,030
December	319	292	301	18,510
The period				121,900

[a] Missing gage heights interpolated.

POWERS CANAL NEAR BISHOP, CAL.

This station was established August 19, 1903, by R. S. Hawley. It is located one-half mile above a mill on Bishop Creek, and 4½ miles west of Bishop, Cal.

The canal is straight for 20 feet above and 50 feet below the station. The bed of the canal is composed of gravel and is not subject to change.

Discharge measurements are made by wading.

The gage is a rod on the left bank of the canal. The bench mark is on granite bowlder 60 feet north of penstock of the mill pressure pipe; elevation, 3.50 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, pp 251-252.
Discharge: 134, p 252.
Discharge, monthly: 134, p 253.
Gage heights: 134, p 252.
Rating table: 134, p 252.

Discharge measurements of Powers canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 3	J. S. Evans	3	0.7	1.00	1.10	0.7
June 21	do	9	6.4	2.66	1.90	17.0
July 27	do	8	5.0	2.36	1.68	11.8
August 10	do	7	1.3	1.08	1.30	1.4
September 7	do	7.5	2.1	1.33	1.40	2.8
November 23	F. R. S. Buttemer	8	1.4	.79	1.25	1.1
December 11	do	8	3.6	.89	1.58	3.2
December 21	do				1.16	1.0

SOUTH HILLSIDE CANAL NEAR BISHOP, CAL.

This station was established August 26, 1903, by R. S. Hawley. It is located just below waste gate at head of canal, 5 miles west of Bishop, Cal.

Discharge measurements are made by wading.

The gage is a rod on the left bank of the canal. The bench mark is on granite bowlder marked by ring of white paint and located on left bank 2 feet from gage; elevation, 2.99 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, p 253.
Discharge: 134, p 253.
Discharge, monthly: 134, p 255.
Gage heights: 134, p 254.
Rating table: 134, p 254.

Discharge measurements of South Hillside canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 21	R. J. Taylor	4.5	0.9	1.11	1.60	1.0
February 8	do	4.5	.9	1.11	1.60	1.0
March 4	do	4.5	1.3	1.46	1.66	1.9
April 18	J. S. Evans	4.8	1.6	1.88	1.70	3.0
May 5	do	4.8	3.2	2.66	2.00	8.5
July 27	do	4.5	2.4	3.29	1.98	7.9
August 10	do	5.0	3.6	2.47	2.00	8.9
September 22	do	4.5	3.2	2.75	2.00	8.8
October 25	F. R. S. Buttemer	4.0	2.0	1.75	1.75	3.5
November 23	do	5.0	1.0	.90	1.58	.9
December 11	do	3.7	.6	.50	1.50	.3

NORTH HILLSIDE CANAL NEAR BISHOP, CAL.

This station was established September 3, 1903, by R. S. Hawley. It is located at head gate of the canal, 5 miles west of Bishop, Cal.

Discharge measurements are made from crosspiece of the flume on which the distances across are marked at each foot. The initial point for soundings is the end of crosspiece of flume at right bank.

The gage is a vertical rod fastened to the right side of flume or head gate. The bench mark is on a granite bowlder marked with white paint and located near gage; elevation, 2.96 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, p 255.
Discharge: 134, p 255.
Discharge, monthly: 134, p 256.
Gage heights: 134, p 256.
Rating table: 134, p 256.

Discharge measurements of North Hillside Canal near Bishop, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 4	R. J. Taylor	4.3	1.8	0.83	1.51	1.5
April 18	J. S. Evans	4	2.2	2.23	1.70	4.9
May 5	do	4	3.6	3.33	2.00	12.0
June 21	do	4	3.0	7.67	2.10	23.0
July 27	do	4	2.4	7.83	2.05	18.8
August 10	do	4	2.6	7.46	2.08	19.4
September 17	do	4	3.2	3.70	1.98	11.8
September 22	do	4.2	2.5	5.20	2.0	13.0
October 23	do	4.0	2.0	1.95	1.70	3.9
November 23	do	6	2.4	1.21	1.70	2.9
December 11	do	4.3	2.2	.32	1.52	.7
December 21	F. R. S. Buttemer	4.5	.8	.75	1.45	.6

BIG PINE CREEK NEAR BIG PINE, CAL.

This station was established December 5, 1903, by R. S. Hawley. It is located 3 miles southwest of Big Pine, Cal., at a point where the creek leaves the foothills.

The channel is straight for 30 feet above and 50 feet below the station. The current is swift at all stages. Both banks are high and rocky. The bed of the stream is rough and rocky, and is not subject to much change.

Discharge measurements are made from a footbridge. The initial point is at the right bank.

The gage is a veritical rod fastened to a tree on the left bank of the creek, 3 feet above the footbridge. During 1905 the gage was read by Mrs. J. M. Randle. Bench marks were established as follows: (1) On a granite bowlder marked by a ring of white paint, 40 feet southeast of the south end of the footbridge; elevation, 8.54 feet; (2) a point marked with a ring of white paint, 45 feet southwest of the south end of the footbridge; elevation, 10.44 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, p 257.
Discharge: 134, pp 257, 260.
Discharge, monthly: 134, p 259.
Gage heights: 134, p 258.
Rating table: 134, p 258.

Discharge measurements of Big Pine Creek near Big Pine, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 18	R. J. Taylor	13	9.9	2.52	1.95	25
February 18	do	12.5	8.5	2.71	1.85	23
April 26	J. S. Evans	13	10.8	2.78	2.20	30
May 19	do	13	13.8	3.70	2.38	51
June 9	do	13	15.8	3.86	2.48	61
July 16	do	13.5	21.0	5.71	2.85	120
August 17	do	13	18.4	4.77	2.60	88
September 13	do	13	13.0	3.15	2.30	41
November 16	F. R. S. Buttermer	10	6.6	1.61	1.85	10.6
December 1	do	13.5	8.8	1.62	2.00	14.3
December 16	do	13.5	12.6	0.83	2.20	10.5
December 16	do	13.5	12.5	0.98	2.20	12.2

[a] Channel changed.

Daily gage height, in feet, of Big Pine Creek near Big Pine, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.85	1.9	1.85	1.8	2.5	2.4	2.95	2.9	2.7	2.25	1.8	.....
2	1.85	1.9	1.9	1.9	2.5	2.4	3.0	2.9	2.6	2.15	.....	1.9
3	1.85	1.9	1.9	1.85	2.5	2.4	3.0	2.9	2.5	2.15	.....	.....
4	1.85	2.0	1.9	1.9	2.5	2.4	3.0	2.9	2.4	2.15	.....	1.9
5	1.85	2.0	1.9	1.9	2.4	2.4	3.0	2.9	2.4	2.1	.....	.....
6	1.85	2.0	1.9	1.85	2.4	2.45	3.0	2.9	2.35	2.0	.....	.....
7	1.85	1.95	1.9	1.85	2.4	2.45	3.0	2.8	2.25	2.0	.....	.....
8	1.85	1.95	1.9	1.9	2.3	2.5	3.0	2.8	2.25	2.0	1.8	.....
9	1.9	1.9	1.9	1.95	2.0	2.5	3.2	2.9	2.2	2.0	.....	1.9
10	1.9	1.9	1.85	1.95	2.0	2.5	3.5	3.0	2.3	2.0	.....	.....
11	1.85	1.9	1.85	1.95	2.0	2.7	3.5	3.0	2.4	2.0	1.85	2.0
12	1.8	1.9	1.9	1.95	2.0	2.8	3.5	3.0	2.4	2.0	.....	.....
13	1.8	1.9	1.9	1.95	2.1	2.9	3.3	2.9	2.45	2.0	.....	.....
14	1.8	1.9	1.9	1.95	2.2	2.9	3.3	2.9	2.45	2.0	.....	.....
15	1.8	1.85	1.9	1.95	2.3	2.9	3.3	2.9	2.45	1.85	1.85	2.0
16	1.85	1.85	1.9	1.95	2.3	2.9	3.05	2.9	2.45	1.85	.....	.....
17	1.85	1.85	1.9	1.95	2.3	2.95	3.2	2.9	2.35	1.8	.....	.....
18	1.85	1.85	1.9	1.95	2.4	3.0	3.1	2.8	2.4	1.8	1.8	.....
19	1.85	1.85	1.9	1.95	2.4	3.0	3.0	2.8	2.45	1.8	.....	.....
20	1.85	1.85	1.9	1.95	2.4	3.0	3.0	2.9	2.45	1.8	.....	2.2
21	1.85	1.85	1.9	1.95	2.5	3.2	3.0	2.8	2.4	1.8	.....	.....
22	1.8	1.85	1.9	1.95	2.5	3.3	3.0	2.8	2.4	1.8	.....	.....
23	1.85	1.85	1.9	2.0	2.4	3.4	3.1	2.7	2.4	1.8	1.85	2.15
24	1.85	1.85	1.9	2.0	2.4	3.2	3.2	2.7	2.35	1.8	.....	.....
25	1.85	1.85	1.9	2.0	2.4	2.8	3.3	2.7	2.3	1.8	.....	.....
26	1.85	1.85	1.9	2.2	2.4	2.8	3.4	2.7	2.3	1.8	.....	2.3
27	1.85	1.85	1.9	2.3	2.4	2.8	3.3	2.7	2.3	1.8	.....	.....
28	1.85	1.85	1.8	2.3	2.4	2.9	3.2	2.7	2.3	1.8	1.85	.....
29	1.85	.....	1.8	2.4	2.4	2.9	3.1	2.7	2.3	1.8	.....	.....
30	1.85	.....	1.8	2.5	2.4	2.9	3.1	2.7	2.3	1.8	.....	.....
31	1.85	.....	1.8	.....	2.4	.....	3.0	2.7	.....	1.8	.....	.....

Station rating table for Big Pine Creek near Big Pine, Cal., from March 21 to December 15, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	9	2.30	40	2.80	115	3.30	220
1.90	11	2.40	52	2.90	134	3.40	244
2.00	15	2.50	66	3.00	154	3.50	268
2.10	21	2.60	81	3.10	175		
2.20	30	2.70	97	3.20	197		

NOTE.—The above table is based on eight discharge measurements made during 1905. It is fairly well defined between gage heights 2 feet and 2.8 feet. The table has been extended beyond these limits, being based on extension of area and mean-velocity curves.

Estimated monthly discharge of Big Pine Creek near Big Pine, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	24	19	21.7	1,334
February	30	22	23.9	1,327
March	24	9	18.9	1,162
April	66	9	17.9	1,065
May	66	15	46.7	2,872
June	244	52	118	7,021
July	268	144	187	11,500
August	154	97	122	7,501
September	97	30	51.1	3,041
October	35	9	13.7	842
November	10	9	9.6	571
December 1-15	15	11	12.5	372
The period				38,610

NOTE.—Discharge January 1 to March 20 based on discharge measurements directly. Rating table used March 21 to December 15. Because of a change in channel the rating table does not apply after December 15.

Discharges for days in November and December, when gage heights are not recorded, were interpolated.

BIRCH CREEK NEAR TINEMAHA, CAL.

This station was established June 14, 1905, by J. S. Evans. It is located 6 miles southwest of Big Pine and 500 feet west of ranch of Charles Peterson.

The channel is straight for 25 feet above and below the station. The water is swift at all stages. Both banks are low, but not subject to overflow. The bed of the stream is composed of coarse gravel and is not subject to material change. The stream flows in one channel.

Discharge measurements are made from a footbridge, which consists of a cottonwood tree placed across the stream. The initial point for soundings is a nail in footbridge on the left bank.

The gage is a vertical staff nailed to a willow tree on the left bank. During 1905 the gage was read by Charles Peterson. The bench mark is a nail in the top of a willow stump on the left bank; elevation, 2.00 feet above the datum of the gage.

Discharge measurements of Birch Creek near Tinemaha, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 14	J. S. Evans	7	9.6	2.19	1.00	21
July 17	do	8	8.0	1.35	.71	10.8
August 24	do	8	7.6	1.00	.58	7.6
November 17	F. R. S. Buttemer	8	6.2	.35	.55	2.2
December 2	do	8	6.0	.42	.55	2.5

Daily gage height, in feet, of Birch Creek near Tinemaha, Cal., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.8	0.65	0.6	0.5	0.35	0.8
2		.75	.65	.55	.4	.35	.55
3		.75	.65	.6	.4	.35	.55
4		.8	.65	.55	.35	.45	.55
5		.8	.6	.55	.35	.5	.5
6		.8	.55	.5	.3	.5	.5
7		.85	.6	.5	.3	.5	.5
8		.9	.65	.45	.3	.5	.5
9		.9	.75	.45	.35	.5	.5
10		.85	.8	.5	.35	.5	
11		.9	.65	.5	.35	.5	
12		.9	.6	.5	.35	.5	
13		.85	.6	.45	.35	.5	
14	1.0	.75	.6	.45	.35	.5	
15		.7	.6	.45	.35	.5	
16		.7	.55	.4	.35	.5	
17		.7	.55	.4	.35	.5	
18	.9	.7	.55	.4	.35	.5	
19	.9	.65	.5	.4	.35	.5	
20	.9	.65	.6	.4	.35	.5	
21	.8	.65	.65	.4	.35	.5	
22	1.0	.65	.65	.4	.35	.5	
23	.8	.7	.55	.4	.35	.5	
24	.9	.7	.55	.4	.35	.5	
25	.75	.75	.55	.4	.35	.5	
26	.75	.8	.55	.4	.35	.5	
27	.75	.8	.6	.4	.35	.5	
28	.75	.75	.6	.4	.35	.65	
29	.8	.7	.65	.45	.35	.7	
30	.85	.65	.65	.45	.35	.6	
31		.65	.65		.35		

INDEPENDENCE CREEK NEAR INDEPENDENCE, CAL.

This station was established June 15, 1905, by J. S. Evans. It is located about 1 mile west of the town of Independence near intake of the city waterworks of Independence.

The channel is straight for 25 feet above and below the gaging station. Both banks are low, but not subject to overflow. The bed of the stream is composed of gravel and rocks. The approximate depth of water is 1.2 feet. The stream discharges in one channel.

Discharge measurements are made by wading. The initial point for soundings is on the right bank.

The gage is a vertical timber nailed to a willow tree on the right bank. During 1905 the gage was read by Milton Levy. The bench mark is a cross on large rock on right bank of the stream; elevation, 1.70 feet above the datum of the gage.

Discharge measurements of Independence Creek near Independence, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 15	J. S. Evans	12	13.6	3.46	1.10	47
July 21	do	12	8.0	2.42	.72	19.4
August 23	do	11	5.0	1.46	.47	7.3
November 11	F. R. S. Buttemer	11	3.9	.79	.35	3.1
December 3	do	11	4.6	.80	.37	3.7

Daily gage height, in feet, of Independence Creek near Independence, Cal., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.9	0.65	0.45	0.35	0.35	0.4
2		.9	.65	.45	.35	.35	.4
3		.85	.65	.45	.35	.35	.4
4		.85	.6	.45	.35	.35	.4
5		.85	.6	.45	.35	.35	.4
6		.85	.6	.45	.35	.35	.4
7		.9	.55	.45	.35	.35	.4
8		.85	.55	.45	.35	.35	.35
9		.85	.55	.45	.3	.35	.4
10		.85	.55	.35	.35	.35	.4
11		.9	.55	.35	.35	.35	.4
12		.9	.55	.35	.35	.35	.3
13		.9	.55	.4	.35	.35	.35
14		.85	.55	.4	.35	.35	.35
15	1.1	.8	.55	.35	.4	.35	.4
16	1.1	.8	.55	.35	.4	.35	.4
17	1.1	.75	.55	.4	.35	.35	.4
18	1.1	.75	.55	.4	.35	.35	.35
19	1.1	.75	.55	.4	.35	.35	.4
20	1.1	.75	.55	.35	.35	.35	.4
21	1.1	.7	.55	.35	.4	.35	.3
22	1.05	.7	.55	.35	.35	.35	.3
23	1.05	.7	.55	.4	.35	.4	.35
24	1.1	.7	.55	.4	.35	.4	.35
25	.95	.7	.55	.35	.35	.4	.3
26	.95	.7	.55	.35	.35	.4	.3
27	.95	.7	.5	.35	.35	.4	.3
28	.95	.7	.5	.35	.35	.4	.35
29	.9	.7	.5	.35	.35	.4	.35
30	.9	.7	.5	.35	.35	.4	.35
31		.65	.45		.35		.35

NOTE.—Gage heights interpolated June 16–20; October 29 to November 10; November 12 to December 2.

Station rating table for Independence Creek near Independence, Cal., from June 15 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	1.6	0.60	12.9	0.80	24	1.00	39
0.40	4.8	0.70	18	0.90	31	1.10	47
0.50	8.5						

NOTE.—The above table is based on five discharge measurements made during 1905. It is well defind between gage heights 0.4 foot and 1.1 feet.

Estimated monthly discharge of Independence Creek near Independence, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 15-30	47	31	41.5	1,317
July	31	15.4	23.5	1,445
August	15.4	6.6	10.9	670
September	6.6	3.1	4.6	274
October	4.8	1.6	3.2	198
November	4.8	3.1	3.6	214
December	4.8	1.6	3.6	223
The period				4,341

OAK CREEK NEAR INDEPENDENCE, CAL.

This station was established June 15, 1905, by J. S. Evans. It is located about 1 mile west of old Fort Independence and 3 miles northwest of the town of Independence.

The channel is straight for a short distance above and below the station. Both banks are low and subject to slight overflow in high water. The bed of the stream is composed of gravel and rocks, with high velocity at all stages. The stream flows in one channel and has an average depth of 1.2 feet.

Discharge measurements are usually made by wading, although a plank placed across the stream is used as a footbridge for higher stages of the water. The initial point for soundings is a nail in the footbridge on the left bank.

The gage is a staff nailed to a stake driven on the left bank of the stream. During 1905 the gage was read by A. M. Bell. The bench mark is a nail driven in the top of a stake set firmly in the ground on the right bank of the stream near the end of the footbridge; elevation, 1.30 feet above the datum of the gage.

Discharge measurements of Oak Creek near Independence, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 15	J. S. Evans	6	8.4	3.81	1.10	32
July 17	do	5	4.4	4.00	.63	17.6
August 23	do	5	2.8	4.18	.30	11.7
November 8	F. R. S. Buttemer	5	3.4	3.24	.35	11.0
December 4	do	6	3.1	1.87	.25	5.8

Daily gage height, in feet, of Oak Creek near Independence, Cal., for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.0	0.6	0.4	0.3	0.3	0.3
2	.....	1.0	.5	.4	.3	.3	.3
3	.....	1.0	.5	.4	.3	.3	.25
4	.....	.9	.5	.4	.3	.3	.25
5	.....	1.0	.5	.4	.2	.3	.3
6	.....	1.0	.5	.3	.2	.4	.3
7	.....	1.0	.5	.3	.2	.4	.25
8	.....	1.0	.5	.3	.3	.3	.25
9	.....	1.0	.5	.3	.3	.4	.25
10	.....	1.1	.5	.3	.3	.3	.25
11	.....	1.1	.5	.3	.3	.3	.25
12	.....	1.1	.5	.3	.3	.3	.25
13	.....	1.0	.5	.3	.3	.3	.3
14	.....	.9	.4	.3	.2	.3	.3
15	.....	.9	.4	.3	.3	.3	.3
16	.....	.8	.4	.2	.2	.3	.3
17	.....	.8	.4	.2	.2	.3	.25
18	1.3	.7	.4	.2	.3	.3	.25
19	1.3	.7	.4	.2	.3	.3	.25
20	1.3	.6	.4	.2	.3	.3	.25
21	1.4	.7	.4	.2	.3	.3	.25
22	1.2	.6	.4	.2	.3	.3	.25
23	1.2	.6	.4	.2	.3	.3	.25
24	1.1	.7	.4	.2	.3	.3	.25
25	1.0	.7	.4	.2	.3	.3	.25
26	1.0	.7	.4	.2	.3	.3	.25
27	1.0	.7	.4	.2	.3	.3	.25
28	.9	.7	.4	.2	.3	.3	.25
29	1.0	.6	.4	.2	.3	.3	.25
30	1.0	.6	.4	.3	.3	.3	.25
31	.....	.6	.4	.....	.3	.....	.25

MISCELLANEOUS MEASUREMENTS IN OWENS RIVER DRAINAGE BASIN.

The following is a list of the miscellaneous discharge measurements made in the Owens River drainage basin during 1905:

Ash Creek near Lone Pine, Cal.—This stream discharges into Owens Lake from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 19: Width, 10 feet; area, 5.4 square feet; mean velocity, 1.96 feet per second; discharge, 10.6 second-feet.

July 19: Width, 4 feet; area, 1 square foot; mean velocity, 1.80 feet per second; discharge, 1.8 second-feet.

Birch Creek near Bishop, Cal.—This stream is tributary to Owens River above Bishop, Cal. A measurement was made August 1, 1905, by J. S. Evans at the point where the stream leaves the foothills and enters the valley.

Width, 6 feet; area, 4.4 square feet; mean velocity, 2.72 feet per second; discharge, 12 second-feet.

Clear Creek near Big Pine, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 7 feet; area, 5.6 square feet; mean velocity, 1.86 feet per second; discharge, 10.4 second-feet.

July 17: Width, 6 feet; area, 3.4 square feet; mean velocity, 1.61 feet per second; discharge, 5.5 second-feet.

Cottonwood Creek near Olancha, Cal.—This stream discharges into Owens Lake from the eastern slope of the Sierra Nevada. The gage rod is a 1 by 3 inch timber graduated to feet and tenths and nailed to a cottonwood tree on the right bank of the stream. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 16: Width, 28 feet; area, 30 square feet; mean velocity, 3.03 feet per second; gage height, 0.80 foot; discharge, 91 second-feet.

July 20: Width, 20 feet; area, 16.2 square feet; mean velocity, 1.86 feet per second; gage height, 0.33 foot; discharge, 30 second-feet.

November 10: Width, 8 feet; area, 5 square feet; mean velocity, 0.86 foot per second; discharge, 4.3 second-feet.

Division Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following discharge measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 4 feet; area, 1.9 square feet; mean velocity, 1.74 feet per second; discharge, 3.3 second-feet.

July 17: Width, 4 feet; area, 1.2 square feet; mean velocity, 1.75 feet per second; discharge, 2.1 second-feet.

December 2: Width, 6.5 feet; area, 2.9 square feet; mean velocity, 1.86 feet per second; discharge, 5.4 second-feet.

Eight Mile Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made December 4, 1905, at a point where the stream leaves the foothills and enters the valley:

Width, 4.5 feet; area, 2.2 square feet; mean velocity, 1.45 feet per second; discharge, 3.2 second-feet.

Fish Springs near Big Pine, Cal.—A measurement was made of the water discharging from these springs on December 4, 1905:

Width, 7 feet; area, 20 square feet; mean velocity, 1.45 feet per second; discharge, 29 second-feet.

Goodale Creek near Tibbetts, Cal.—This stream is a tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 4.5 feet; area, 2.6 square feet; mean velocity, 2.27 feet per second; discharge, 5.9 second-feet.

July 17: Width, 3.5 feet; area, 1.8 square feet; mean velocity, 1.94 feet per second; discharge, 3.5 second-feet.

August 22: Width, 3 feet; area, 1.5 square feet; mean velocity, 2.26 feet per second; discharge, 3.4 second-feet.

November 17: Width, 3.7 feet; area, 2.2 square feet; mean velocity, 2.09 feet per second; discharge, 4.6 second-feet.

Georges Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made June 15, 1905, at a point where the stream leaves the foothills and enters the valley:

Width, 11 feet; area, 9.2 square feet; mean velocity, 2.61 feet per second; discharge, 24 second-feet.

Lone Pine Creek near Lone Pine, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 15: Width, 13 feet; area, 14.2 square feet; mean velocity, 2.61 feet per second; discharge, 37 second-feet.

July 19: Width, 13 feet; area, 13 square feet; mean velocity, 2.31 feet per second; discharge, 30 second-feet.

November 9: Width, 12.5 feet; area, 4.2 square feet; mean velocity, 0.83 foot per second; discharge, 3.5 second-feet.

Moffett Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made on June 15 at a point where the stream leaves the foothills and enters the valley:

Width, 7 feet; area, 4 square feet; mean velocity, 2.25 feet per second; discharge, 9 second-feet.

McGee Creek near Bishop, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made on August 1, 1905, at a point where the stream leaves the foothills and enters the valley:

Width, 4 feet; area, 4 square feet; mean velocity, 2.18 feet per second; discharge, 8.7 second-feet.

Shepherds Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 15: Width, 6 feet; area, 6 square feet; mean velocity, 2.53 feet per second; discharge, 15.2 second-feet.

July 18: Width, 6 feet; area, 2.7 square feet; mean velocity, 2.37 feet per second; discharge, 6.4 second-feet.

Taboose Creek near Tibbetts, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The gage rod is a 1 by 3 inch timber graduated to feet and tenths and nailed to a willow tree on the left bank of the stream. The bench mark is a nail in willow tree on the left bank, to which gage is fastened. Its elevation is 1.60 feet above the zero of the gage. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 10 feet; area, 10.6 square feet; mean velocity, 1.68 feet per second; gage height, 0.60 foot; discharge, 17.8 second-feet.

July 17: Width, 10 feet; area, 6.6 square feet; mean velocity, 1.82 feet per second; gage height, 0.40 foot; discharge, 12 second-feet.

August 24: Width, 10 feet; area, 3 square feet; mean velocity, 1.67 feet per second; gage height, 0.10 foot; discharge, 5 second-feet.

November 17: Width, 7 feet; area, 3.8 square feet; mean velocity, 1 foot per second; gage height, 0.10 foot; discharge, 3.8 second-feet.

December 2: Width, 7 feet; area, 4.6 square feet; mean velocity, 1 foot per second; gage height, 0.15 foot; discharge, 4.6 second-foot.

Tuttle Creek near Lone Pine, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at the point where the stream leaves the foothills and enters the valley:

June 16: Width, 12 feet; area, 6 square feet; mean velocity, 1.80 feet per second; discharge, 10.8 second-feet.

July 19: Width, 10 feet; area, 4.5 square feet; mean velocity, 2.40 feet per second; discharge, 10.8 second-feet.

Tinemaha Creek near Tinemaha, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at the point where the stream leaves the foothills and enters the valley:

June 14: Width, 8 feet; area, 10.5 square feet; mean velocity, 1.86 feet per second; discharge, 19.5 second-feet.

July 17: Width, 6 feet; area, 4.4 square feet; mean velocity, 3.36 feet per second; discharge, 14.8 second-feet.

December 2: Width, 7 feet; area, 5.2 square feet; mean velocity, 0.60 foot per second; discharge, 3.1 second-feet.

MOHAVE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Mohave River rises on the northern slope of the San Bernardino Mountains, and, flowing in a northerly direction, finally disappears in the sands of the Mohave Desert. This stream has few tributaries, the only ones of importance being West Fork and Deep Creek, which have their source in the higher elevations of the San Bernardino Mountains. The formation is of granite, with good covering of soil. On the higher elevations there is a considerable growth of timber, which diminishes as one approaches the lower reaches, changing to a light growth of brush and grass, finally merging into the barren desert. During the greater portion of the year the stream bed is dry below the junction of West Fork and Deep Creek, where the waters disappear in the sand and gravelly bed of the stream. Water again rises at a point lower down on the river above Victorville, where the gaging station is located. Water is diverted above and below the gaging station, but is again returned to the river channel. There are several artesian wells along the river above the gaging station, the water being used for irrigation. This stream does not discharge in any large quantity except during an extremely heavy rainfall in the winter months. The precipitation throughout this basin is very light, with the possible exception of the higher elevation of the San Bernardino Mountains, where there is a considerable fall of snow during the winter months, which melts in the early spring.

MOHAVE RIVER AT VICTORVILLE, CAL.

This station was established February 27, 1899, by Bert Cole. It is located in the town of Victorville, a station on the Atchison, Topeka and Santa Fe Railroad, where the Mohave River passes through a narrow gorge locally known as the "Narrows." This place has been under investigation as a possible dam site, and soundings for the depth of bed rock were made by the United States Geological Survey during the season of 1899. The greatest depth of bed rock was found to be 54 feet. The diamond drill showed the rock to be a fine granite. A more detailed account of this exploration will be found in the Twenty-first Annual Report, part 4. Above the "Narrows" the valley broadens into a large reservoir site, but as no surveys of it have been made the capacity is unknown.

The channel is straight for 300 feet above and below the section where the rod is located. Both banks are high and rocky and not subject to overflow. The channel is composed of sand, which is constantly shifting.

During medium and low stages discharge measurements are made from a low foot bridge or by wading. During floods discharge measurements are made from the county bridge. The mean estimated monthly discharge is obtained by averaging the discharge measurements made during the year.

Gage readings were discontinued in 1902. On March 1, 1905, a new inclined rod was fastened to the rock on the left bank about 300 feet above the county bridge. This gage was established as a matter of interest in connection with the discharge of the stream at high stages. There is no relation between gage readings and the discharge, as the bed of the stream is constantly changing at different stages of the river. During 1905 discharge measurements were made twice each week, and the gage was read by P. H. Leahy. The bench mark is a bolt sulphured in solid rock on the left bank, about 15 feet from the Santa Fe Railroad track and 40 feet west of the gage rod. It is 20.45 feet above the datum of the gage. Elevation, 2,726.52 feet above sea level, as established by connection with a standard United States Geological Survey bench mark at Victorville.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Discharge measurements of Mohave River at Victorville, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet*	*Sec.-ft.*
January 3	P. H. Leahy		56	June 27	P. H. Leahy		30
January 6	do		58	June 30	do		35
January 10	do		70	July 3	do		36
January 13	do		71	July 7	do		32
January 17	do		59	July 11	do		31
January 20	do		59	July 14	do		27
January 25	do		56	July 18	do		36
January 27	do		53	July 21	do		32
January 31	do		56	July 25	do		30
February 5	do		822	July 28	do		34
February 8	do		82	August 2	do		30
February 11	do		90	August 5	do		29
February 15	do		2,032	August 25	do		36
February 18	do		97	August 28	do		29
February 21	do		95	August 31	do		35
March 2	do	3.96	98	September 1	do		47
March 3	E. C. La Rue	3.92	90	September 5	do		35
March 6	P. H. Leahy	3.85	91	September 8	do		35
March 11	do	3.77	74	September 11	do		37
March 13	do	9.90	5,410	September 15	do		42
March 15	do	4.50	820	September 19	do		43
March 16	O. W. Peterson	4.95	2,350	September 22	do		43
March 18	P. H. Leahy	4.06	980	September 26	do		42
March 22	do	4.04	740	September 29	do		42
March 25	do		460	October 3	do		40
March 27	do	4 0	340	October 6	do		49
March 31	do	3.91	290	October 10	do		41
April 6	R. S. Hawley	3.75	133	October 13	do		44
April 8	P. H. Leahy	3.75	133	October 17	do		44
April 11	do	3.7	123	October 20	do		54
April 14	do	3.66	104	October 24	do		51
April 18	do	3.58	93	October 27	do		50
April 24	do	3.5	60	October 31	do	4.20	49
April 25	R. S. Hawley	3.5	38	November 3	do	4.20	46
April 29	P. H. Leahy	3.45	58	November 7	do	4.29	81
May 3	do	3.76	151	November 10	do	4.21	66
May 6	do	3.98	218	November 14	do	4.20	62
May 10	do	4.60	327	November 17	do	4.16	58
May 13	do		260	November 22	do	4.15	65
May 16	do		152	November 24	do	4.16	73
May 20	do	3.98	80	November 28	do	4.15	67
May 23	do		65	December 1	do	4.16	65
May 27	do		55	December 5	do	4.09	72
May 29	do		48	December 8	do	4.09	67
June 2	do		63	December 12	do	4.02	65
June 6	do		51	December 15	do	4.02	73
June 10	do		46	December 19	do	4.05	71
June 13	do		39	December 22	do	4.05	67
June 16	do		43	December 26	do	4.03	66
June 20	do		43	December 30	do	4.03	58

Daily gage height, in feet, of Mohave River at Victorville, Cal., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	3.9	3.45	4.0	4.05	4.0	4.0	4.1	4.2	4.15
2	3.95	3.9	3.5	4.0	4.0	4.0	4.0	4.1	4.2	4.15
3	.....	3.85	3.65	4.0	4.0	4.0	4.0	4.1	4.2	4.15
4	3.95	3.9	3.85	4.0	4.0	4.0	4.0	4.1	4.2	4.15
5	3.85	3.8	3.95	4.0	4.0	4.0	4.0	4.1	4.2	4.15
6	3.85	3.75	4.0	4.0	4.0	4.0	4.0	4.15	4.2	4.1
7	3.8	3.75	4.85	4.0	4.0	4.0	4.0	4.15	4.3	4.1
8	3.8	3.4	4.85	4.0	4.0	4.0	4.0	4.15	4.3	4.1
9	3.8	3.4	.....	4.0	4.0	4.0	4.0	4.15	4.25	4.1
10	3.75	3.65	4.6	4.0	4.0	4.0	4.0	4.15	4.2	4.05
11	3.75	3.65	4.6	4.0	4.0	4.0	4.0	4.15	4.2	4.05
12	3.75	3.65	4.2	4.0	4.0	4.0	4.0	4.15	4.2	4.0
13	9.95	3.65	4.2	4.05	4.0	4.0	4.0	4.15	4.2	4.0
14	5.0	3.65	4.1	4.05	4.0	4.0	4.0	4.15	4.2	4.0
15	5.0	3.6	4.1	4.05	4.0	4.0	4.0	4.15	4.2	4.0
16	5.05	3.6	4.05	4.05	4.0	4.0	4.0	4.15	4.15	4.0
17	4.1	3.6	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.0
18	4.05	3.6	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
19	4.05	3.55	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
20	4.05	3.65	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
21	4.05	3.6	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
22	4.05	3.6	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
23	4.0	3.5	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
24	4.0	3.5	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
25	4.0	3.5	3.95	4.05	4.0	4.0	4.0	4.2	4.2	4.05
26	4.0	3.5	3.95	4.05	4.0	4.0	4.0	4.2	4.2	4.05
27	4.0	3.45	4.0	4.05	4.0	4.0	4.0	4.2	4.15	4.05
28	3.85	3.45	4.2	4.05	4.0	4.0	4.0	4.2	4.15	4.05
29	3.8	3.45	4.1	4.05	4.0	4.0	4.0	4.2	4.15	4.05
30	4.2	3.45	4.1	4.05	4.0	4.0	4.0	4.2	4.15	4.05
31	3.9	.....	4.0	.....	4.0	4.0	4.0	4.2	.....	4.05

Daily discharge, in feet, of Mohave River at Victorville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	56	60	100	263	60	61	35	30	a 47	40	48	a 65
2	56	325	a 98	237	100	a 63	36	a 30	44	40	47	66
3	a 56	605	a 90	211	a 151	60	a 36	30	41	a 40	a 46	68
4	57	713	90	185	172	57	35	29	38	40	55	70
5	58	a 822	91	159	195	54	34	a 29	a 35	44	64	a 72
6	a 58	576	a 91	a 133	a 218	a 51	33	29	35	a 49	72	67
7	61	328	88	133	246	50	a 32	29	35	47	a 81	67
8	64	a 82	84	a 133	272	49	32	29	a 35	45	76	a 67
9	67	84	81	133	300	47	32	29	35	43	71	67
10	a 70	87	77	128	a 327	a 46	31	29	36	a 41	a 66	66
11	70	a 90	a 74	a 123	296	44	a 31	29	a 37	41	65	66
12	71	90	74	118	273	41	29	29	38	41	64	a 65
13	a 71	90	a 5,410	110	a 260	a 39	28	29	39	a 44	63	67
14	68	90	2,295	a 104	224	40	a 27	31	40	44	a 62	70
15	65	a 2,032	a 820	103	188	41	29	31	a 42	44	61	a 73
16	62	1,387	a 2,250	98	a 152	a 43	31	33	42	44	59	73
17	a 59	150	1,665	95	134	43	34	33	42	a 44	a 58	72
18	59	a 97	a 980	a 93	116	43	a 36	33	42	47	60	71
19	59	96	920	86	98	43	35	33	a 43	50	61	a 71
20	a 59	95	860	79	a 80	a 43	33	33	43	a 54	62	70
21	59	a 95	800	75	75	41	a 32	36	43	53	64	68
22	59	95	a 740	70	70	39	32	36	a 43	52	a 65	a 67
23	58	95	647	65	a 65	37	32	36	42	51	69	67
24	57	95	553	a 60	63	35	31	36	42	a 51	a 73	67
25	a 56	95	a 460	a 38	60	33	a 30	a 36	42	51	71	67
26	55	95	450	43	58	31	32	33	a 42	51	70	a 66
27	a 53	95	a 340	48	a 55	a 30	33	31	42	a 50	69	64
28	54	95	327	53	52	31	a 34	a 29	42	50	a 67	62
29	54	.....	315	a 58	a 48	33	32	31	a 42	50	67	60
30	55	.....	302	60	53	a 35	32	33	42	49	66	a 58
31	a 56	.....	290	.....	57	.....	32	a 35	.....	a 49	.....	58

a Taken from discharge measurements.

NOTE.—Daily discharge obtained by interpolation between discharge measurements.

Estimated monthly discharge of Mohave River at Victorville, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	71	53	60.1	3,695
February	2,032	60	309	17,160
March	5,410	74	695	42,734
April	263	38	110	6,545
May	327	48	146	8,977
June	63	30	43.4	2,583
July	36	27	32.3	1,986
August	36	29	31.6	1,943
September	47	34	40.0	2,380
October	54	40	46.5	2,859
November	81	46	64.0	3,808
December	73	58	67.0	4,120
The year	5,410	27	137	98,790

SOUTHERN PACIFIC OCEAN DRAINAGE.

GENERAL FEATURES.

The Southern Pacific Ocean drainage includes those streams south of San Francisco Bay whose waters, in times of flood at least, reach the Pacific Ocean.

SAN LUIS REY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The San Luis Rey River rises on the western slope of the Coast Range in the northern portion of San Diego County, and, flowing in a westerly direction, discharges its waters into the Pacific Ocean near the town of Oceanside. It has numerous small tributaries, none of which have their sources at elevations above 5,000 feet. On the upper reaches of this stream the country is rolling, with several small valleys which are under cultivation, being used principally for the raising of grain and the pasturage of stock. At a point below what is known as Warner's ranch reservoir site the river flows through a deep, narrow canyon, with a heavy grade for a distance of about 10 miles, below which point the grade is light and the discharge is over a sandy and gravelly bed, where the water soon disappears, again rising in small quantities near the town of Pala, where the gaging station is located. Below this point it flows for a distance of about 25 miles on a light grade to the Pacific Ocean. There is a good soil covering throughout this basin, with a considerable growth of brush and grass, and with small areas of timber on the extreme higher elevations. The water is diverted at several points along this stream for irrigation, a considerable quantity being diverted from the canyon above the gaging station and used in the vicinity of Escondido, which lies in an entirely separate drainage basin. This stream is torrential in its character, the discharge being very light except during the winter season, in times of heavy rainfall. The mean precipitation varies from 10 to 20 inches and falls principally in the form of rain, there being only a light fall of snow on the extreme higher elevations, which soon melts and only adds to the flood discharge.

SAN LUIS REY RIVER NEAR PALA, CAL.

This station was established October 9, 1903, by W. B. Clapp. It is located at Sickler's mill, 4 miles above Pala, Cal. It is reached by driving from Fallbrook or Temecula, stations on the Southern California Railway, 18 and 13 miles distant, respectively.

The channel is straight for about 800 feet above and 2,000 feet below the station. The grade of the stream is 0.60 foot in 100 feet. The current is swift. The right bank rises abruptly about 15 feet beyond the oak tree to which the cable is fastened and is not liable to overflow. The left bank is low, but is not liable to overflow. It was once a portion of the river channel, but is now well above high-water marks. The bed of the stream is rocky in portions of the flood channel, but the low-water channel is clear of rocks. There is a considerable growth of small timber in the channel, but this has been cleared the entire width of the cross section for a distance of 100 feet above and 50 feet below the station. This timber growth is not permanent, being washed out by floods every few years.

Discharge measurements are usually made by wading. During high water they are made from a car suspended from a cable stretched across the river at the gage. The initial point for soundings is the base of the oak tree to which the left end of the cable is fastened.

The gage is an inclined staff fastened to tree stumps and stakes at the left bank of the river. During 1905 the gage was read once each day by M. M. Sickler. The bench mark is a United States standard bronze-capped iron post set flush with the ground on the right bank of the river and the north side of the wagon road, and about 50 feet west from the line of the cable prolonged. Its elevation is 557 feet above mean sea level and 26.98 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of San Luis Rey River near Pala, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 8	E. C. La Rue	44	43	2.51	2.25	108
February 17	F. M. Sickler	51	70	2.69	2.72	188
February 18	do	100	204	3.60	4.75	735
March 17	do	188	679	7.14	7.50	5,180
March 22	R. S. Hawley	67	100	3.05	2.64	305
March 22	F. M. Sickler	68	96	3.11	2.64	299
April 11	do	44	42	2.48	1.80	104
May 15	do	41	26	1.88	1.20	49
May 17	do	40	21	1.90	1.10	40
May 20	do	43	25	2.28	1.40	57
July 6	do	3.0	1.7	2.06	.55	3.5
August 8	R. S. Hawley	3.6	1.7	1.74	(a)	3
August 19	M. M. Sickler	3.5	1.6	2.00	.....	3.2
August 26	do	3.5	1.6	2.06	.....	3.3
September 2	do	3.5	1.5	1.80	.....	2.7
September 9	do	3.5	1.5	1.80	.....	2.7
September 16	do	3.5	1.4	1.78	.....	2.5
September 21	D. W. Murphy	.....	.....	.....	.....	2.1
September 23	F. M. Sickler	3.5	1.4	2.00	.42	2.8
October 28	do	3.5	1.6	2.25	.53	3.6
December 27	do	7	4.1	3.15	.63	12.9
December 29	do	10.9	6.7	1.40	.61	9.4

a Channel so uncertain from July 11 to September 23 that no readings were made.

Estimated monthly discharge of San Luis Rey River near Pala, Cal., for 1903–1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1903.				
October (23 days)	1.5	1.0	1.1	50
November	1.5	1.0	1.4	83
December	1.5	1.0	1.2	74
The period	.....	.....	.....	207
1904.				
January	1.5	1.5	1.5	92
February	2.5	1.5	2.0	115
March	348	1.5	41.6	2,558
April	104	20	43.6	2,595
May	35	12	16.2	996
June	12	9	10.8	643
July	9	3	3.8	234
August	2	2	2.0	123
September	2	2	2.0	119
October	13	2	2.5	154
November	3	2	2.4	143
December	5.5	2	3.7	227
The year	348	1.5	11.0	7,999
1905.				
January	66	3	19.1	1,174
February	711	13	151	8,386
March	4,265	2	336	20,660
April	139	27	64.9	3,862
May	282	27	88.1	5,417
June	35	11	23	1,369
July	9	3	4.1	252
August	3.5	3	3	184
September	3.0	2.5	2.6	155
October	3.8	2.8	3.2	197
November	96.0	3.8	17.8	1,059
December	47.0	10	18.3	1,125
The year	4,265	2.0	60.9	43,840

NOTE.—The estimated monthly discharge is approximate only.

SANTA ANA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Santa Ana River has its source in the southern slope of the San Bernardino Mountains and, flowing in a southwesterly direction, traverses San Bernardino Valley, below which it breaks in a narrow canyon through the Santa Ana Mountains, finally discharging its waters through Santa Ana Valley into the Pacific Ocean below the town of Santa Ana. This stream has numerous tributaries which rise in the southern slope of the San Bernardino Mountains, the surface flow of most of which only reach Santa Ana River, where it traverses San Bernardino Valley in times of flood discharge. The topography on the higher elevations is rough and rugged, reaching elevations of from 10,000 to 12,000 feet, the formation being of granite with good soil covering and considerable growth of timber. On the lower elevations the topography is less rough and the soil covering is principally of brush. A gaging station is located on this stream at a point known as Warm Springs, a distance of about 8 miles above Redlands. Below this station the river leaves the mountainous country and discharges over a sandy and gravelly bed through San Bernardino Valley. During the summer months the entire flow of the stream is diverted above this gaging station and used for power development at the mouth of the canyon, below which point it is again taken out and used for irrigation on the higher elevations of San Bernardino Valley along the base of the mountains where the country is under a high state of cultivation, used principally for the raising of citrus fruits. The water rises to the surface in San Bernardino Valley near the city of San Bernardino and is diverted and used extensively for irrigation in the neighborhood of Riverside. In addition to this surface flow a large number of wells have been sunk in this territory, many of which are artesian, and from others the water is being pumped. This developed water is also used extensively for irrigation in the vicinity of San Bernardino and Riverside. The water is again forced to the surface by bed-rock obstructions at Riverside Narrows below the city of Riverside, and gradually increases in volume until it reaches Santa Ana Canyon, where it is diverted for irrigation on the lower valley lands in the vicinity of Santa Ana and Fullerton. During the summer months measurements are made of the flow at Rincon, Cal., at the head of Santa Ana Canyon. There are only occasional flood discharges of this river which flow continuously from the mountain to the sea. The mean precipitation throughout this basin is from 15 to 30 inches, which falls in the form of rain except on the higher elevations of the San Bernardino Mountains, where there is a considerable snowfall, which usually remains on the extreme high elevations until midsummer. A storage reservoir has been constructed on Bear Creek, a tributary of this stream, and is known as the Bear Valley reservoir. This stored water is held until the summer months and used for irrigation in San Bernardino Valley.

SANTA ANA RIVER NEAR MENTONE, CAL.

This station was established in June, 1896. It is located 5 miles northeast of Mentone, Cal., three-fourths of a mile below the headworks of the Mentone Power Company's canal, and opposite the warm springs in the canyon.

The Edison Electric Company diverts the greater portion of the water from Santa Ana River above the gaging station, but also returns all of it above the station. They, however, allow only limited portions of the water to pass out of their conduits during certain hours of the day, holding back the water for the purpose of obtaining additional power when the greatest demand exists.

The Mentone Power Company's canal, formerly called the Santa Ana canal, diverts water above the station, all of which is returned below the point of measurement. During the low-water season the entire flow of the river is diverted by the canals.

The channel is straight for 100 feet above and below the station, and has a width of 22 feet at low and 125 feet at high stages. The current is swift at all stages. The right bank is low and is liable to overflow at flood stages for about 100 feet. The left bank is low but is

not liable to overflow. Both banks are overgrown with alders. The bed of the stream is composed of firm sand and small bowlders. It is subject to considerable change during flood stages.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the bench-mark spike set in the north side of a cottonwood tree on the left bank, 30 feet west of the tree to which the cable is fastened. At flood stages the velocity is so high that measurements can be made only by means of floats.

The gage is an inclined timber fastened to a large bowlder on the left bank 100 feet above the cable. The channel was deepened by a flood March 31, 1903, and the gage was accordingly lowered to reach low-water stages June 30, 1903. During 1905 the gage was read once each day by A. Laird. The bench mark is a spike in the north side of the cottonwood tree on the left bank, 30 feet west of the tree to which the cable is fastened; elevation, 7.29 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Discharge measurements of Santa Ana River near Mentone, Cal., in 1905.

Date.	Hydrographer.	Gage height of river.	Discharge.		
			River.	Mentone Power Company's canal.	Total for River.
		Feet.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
February 13	Clapp and La Rue	1.15	10	40	50
February 21	E. C. La Rue	1.70	17	74	91
February 22	do	1.65	10	71	81
February 23	do	1.65	11	63	74
March 14 a. m	do	2.60	188	0	188
March 14 p. m	do	2.50	138	50	188
March 15 a. m	do	2.30	132	57	189
March 15 p. m	do	2.10	113	57	170
March 30	R. S. Hawley	1.90	81	46	127
April 14, 1 p. m	do	1.95	86	1	87
May 17	do	2.25	111	37	148
June 7	do	2.20	79	0	79
June 26	do	1.43	4	66	70
July 6	do	1.40	3	61	64

Daily gage height, in feet, of Santa Ana River near Mentone, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.85	0.8	1.3	1.7	1.3	2.3	1.4	1.3	1.3	1.3	1.3	1.5
2	.85	2.5	1.3	2.05	2.2	2.3	1.4	1.3	1.3	1.3	1.3	1.5
3	.85	2.3	1.3	2.05	2.0	2.3	1.4	1.3	1.3	1.3	1.3	1.4
4	.85	2.8	1.3	1.35	2.0	2.3	1.4	1.3	1.3	1.3	1.3	1.4
5	.85	3.0	1.3	1.35	1.9	2.3	1.4	1.3	1.3	1.3	1.3	1.4
6	.85	1.9	1.25	1.35	1.9	2.25	1.4	1.3	1.3	1.3	1.3	1.4
7	.85	1.9	1.25	1.35	2.0	2.25	1.4	1.3	1.3	1.3	1.35	1.4
8	.85	1.75	1.25	1.35	2.3	2.2	1.4	1.3	1.3	1.3	1.4	1.4
9	2.0	1.5	1.25	1.35	2.2	2.2	1.4	1.3	1.3	1.3	1.35	1.4
10	1.0	1.5	1.25	1.35	2.2	2.2	1.4	1.3	1.3	1.3	1.3	1.4
11	.85	1.35	1.25	1.35	2.2	2.15	1.4	1.3	1.3	1.3	1.3	1.4
12	.85	1.25	1.3	1.35	2.2	1.6	1.4	1.3	1.3	1.3	1.3	1.4
13	.85	1.15	3.4	1.3	2.2	1.75	1.4	1.3	1.3	1.3	1.3	1.4
14	.85	1.1	2.6	1.3	2.5	1.6	1.4	1.3	1.3	1.3	1.3	1.4
15	.85	1.1	2.35	1.3	2.5	1.45	1.4	1.3	1.3	1.3	1.3	1.4
16	.8	2.8	2.4	1.3	2.6	1.45	1.35	1.3	1.3	1.3	1.3	1.4
17	.8	2.1	2.5	2.2	2.6	1.6	1.35	1.3	1.3	1.3	1.3	1.4
18	.8	1.9	2.6	2.0	2.5	1.6	1.35	1.3	1.3	1.3	1.3	1.4
19	.8	1.9	2.5	2.1	2.6	1.55	1.35	1.3	1.3	1.3	1.35	1.6
20	.8	1.8	2.6	1.2	2.6	1.55	1.35	1.3	1.3	1.3	1.35	2.2
21	1.65	1.7	2.5	1.15	2.5	1.45	1.35	1.3	1.3	1.3	1.4	1.6
22	.85	1.7	2.4	1.2	2.2	1.45	1.35	1.3	1.3	1.3	1.35	1.5
23	.85	1.5	2.0	1.4	2.2	1.45	1.35	1.3	1.3	1.3	1.35	1.5
24	.85	1.3	1.9	1.4	2.1	1.45	1.3	1.3	1.3	1.3	1.35	1.5
25	.85	1.85	1.9	1.3	2.3	1.45	1.3	1.3	1.3	1.3	1.35	1.5
26	.85	1.25	1.9	1.3	2.2	1.45	1.3	1.3	1.3	1.3	1.8	1.5
27	.85	1.35	1.8	1.3	2.2	1.45	1.3	1.3	1.3	1.3	2.5	1.5
28	.85	1.3	1.65	1.25	2.4	1.4	1.3	1.3	1.3	1.3	2.9	1.5
29	.8	.....	1.5	1.2	2.4	1.4	1.3	1.3	1.3	1.3	1.7	2.0
30	.8	.....	2.0	1.2	2.4	1.4	1.3	1.3	1.3	1.3	1.5	1.6
31	.8	.....	1.8	.....	2.4	.....	1.3	1.3	.....	1.3	.....	1.5

Station rating table for Santa Ana River near Mentone, Cal., from January 1 to February 17, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	1	1.40	23	2.00	80	2.60	170
0.90	2	1.50	29	2.10	93	2.70	186
1.00	5	1.60	37	2.20	106	2.80	202
1.10	8	1.70	47	2.30	122	2.90	218
1.20	12	1.80	57	2.40	138	3.00	234
1.30	17	1.90	68	2.50	154		

Station rating table for Santa Ana River near Mentone, Cal., from February 18 to March 12 and from June 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	1	2.00	48	2.70	164	3.40	290
1.40	3	2.10	62	2.80	182	3.50	308
1.50	6	2.20	78	2.90	200	3.60	326
1.60	11	2.30	94	3.00	218	3.70	344
1.70	17	2.40	110	3.10	236	3.80	362
1.80	25	2.50	128	3.20	254	3.90	380
1.90	35	2.60	146	3.30	272		

Station rating table for Santa Ana River near Mentone, Cal., from March 13 to May 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	1	1.60	46	2.40	151	3.20	287
0.90	2	1.70	56	2.50	168	3.30	304
1.00	4	1.80	68	2.60	185	3.40	321
1.10	8	1.90	80	2.70	202	3.50	338
1.20	13	2.00	92	2.80	219	3.60	355
1.30	20	2.10	106	2.90	236	3.70	362
1.40	28	2.20	120	3.00	253	3.80	379
1.50	36	2.30	135	3.10	270		

Daily discharge, in second-feet, of Santa Ana canal near Mentone, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	22	25	60	57	71	0	63	53	66	51	46	34
2	22	64	57	0	66	0	61	53	63	51	32	32
3	21	64	60	0	66	0	61	51	63	56	32	34
4	21	0	60	54	56	0	61	61	63	56	32	32
5	21	0	60	63	58	0	61	61	66	51	32	32
6	22	22	57	63	73	0	61	61	66	46	36	32
7	21	42	57	63	51	0	58	63	66	46	41	32
8	20	37	54	72	56	0	58	63	61	41	46	32
9	0	37	51	78	66	0	56	63	61	56	41	32
10	61	35	48	78	76	0	56	63	63	46	29	30
11	54	43	48	72	76	0	58	63	73	46	29	32
12	41	26	51	66	76	66	61	63	76	61	30	32
13	41	28	0	66	76	43	63	66	76	66	32	29
14	31	29	0	63	0	71	66	68	78	56	30	29
15	31	35	0	57	0	71	66	68	78	61	30	32
16	27	29	97	43	71	71	63	71	78	56	29	30
17	29	32	78	0	71	68	63	71	78	51	29	30
18	33	42	0	0	71	68	63	81	78	46	29	29
19	25	70	0	0	36	68	61	81	73	43	29	29
20	27	70	0	71	36	68	61	56	68	41	29	29
21	66	70	0	66	32	68	61	56	68	41	34	32
22	61	74	78	66	29	68	61	56	61	46	32	25
23	49	74	66	66	29	68	61	56	68	41	30	25
24	40	66	78	66	29	68	61	73	68	41	29	25
25	31	66	78	71	0	68	61	73	51	46	30	25
26	29	58	60	71	0	68	61	73	56	46	30	25
27	27	51	85	66	0	68	61	76	56	41	41	29
28	25	58	85	66	0	63	61	76	66	41	50	28
29	25	.....	78	71	0	63	61	76	66	41	41	30
30	25	.....	42	76	0	63	56	73	66	41	32	29
31	25	.....	57	.....	0	.....	56	73	.....	41	.....	27

Estimated monthly discharge of Santa Ana [a] River near Mentone, Cal., for 1905.

[Drainage area, 182 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	108	22	36.6	2,251	0.201	0.232
February	234	26	97.6	5,420	.536	.558
March	321	48	130	7,993	.714	.823
April	120	63	90.5	5,385	.497	.554
May	256	91	172	10,580	.945	1.09
June	94	64	77.7	4,624	.427	.476
July	69	57	62.9	3,867	.346	.399
August	82	52	66.8	4,107	.367	.423
September	79	52	68.3	4,064	.375	.418
October	67	42	49.2	3,025	.270	.311
November	250	30	47.5	2,827	.261	.291
December	107	31	38.4	2,362	.211	.243
The year	321	22	78.1	56,500	.429	5.82

[a] Including Mentone Power Company's canal.

SEEPAGE MEASUREMENTS.

In the vicinity of Colton and San Bernardino large quantities of water are developed in addition to the natural surface flow. This water is used for the irrigation of land in the vicinity of San Bernardino, Colton, and Riverside, and also for domestic supply for these towns. Much of this water returns to Santa Ana River below Riverside, above a point known as Slover Mountain and is again diverted and used for irrigation on the lower lands below Riverside, and above what is known as Riverside Narrows. Below this point there are still further diversions which irrigate the lower lands along the river bottom, much of this water again returning to the river above Rincon. Measurements were made during the summer of 1905 to determine the amount of water, including the natural flow and developed water, above Colton, Cal. Also measurements were made of natural flow and developed water below Slover Mountain and above Riverside Narrows, this all being return water from irrigated lands on the higher elevations. Measurements were also made of diversion ditches and Santa Ana River below Riverside Narrows and above what is known as the Auburndale Bridge. The following tabulations show the result of these measurements which were made by K. Sanborn, of Riverside, Cal.

Natural flow of return water to Santa Ana River in second-feet, compared with developed water in San Bernardino Valley above Colton, Cal., 1905.

[Measurements by K. Sanborn, engineer Riverside Water Company.]

Date.	Location.	Developed.	Natural.	Total.
		Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*
June 9	Barnhill pumping plant	1.10		1.10
September 27	do	.80		.80
June 10	Beam ditch		0.00	.00
September 2	do		.00	.00
June 16	Bloomington pumping plants	6.62		6.62
September 27	do	7.20		7 20
June 10	City of San Bernardino, Sixth street pumping plant.	1.99		1.99
September 27	do	4.80		4.80
June 19	Cty of San Bernardino, Lytle Creek		2.04	2.04
September 27	do		1.90	1.90
June 9	City of Colton pumping plant (total)	3.81		3.81
September 27	City of Colton (water used for irrigation)	1.20		1.20
September 27	City of Colton pumping plant (total)	2.70		2.70
May 31	Camp Carlton ditch	2.60		2.60
August 14	do	1.20		1.20
June 10	Carr pumping plant	.72		.72
August 14	do	.60		.60
June 10	Daley ditch		.00	.00
September 4	do		.00	.00
May 30	Excelsior Land and Water Co	.65		.65
September 28	do	.40		.40
May 31	Grand Terrace Pumping Co. pumping plant	.54		.54
August 14	do	.00		.00
May 31	Gage canal, Palm avenue weir	28.83		28.83
September 2	do	32.70		32.70
May 26	Gage canal intake, Santa Ana River		.00	.00
September 4	do		.00	.00
June 2	Haws & Talmadge ditch		.00	.00
September 5	do		.00	.00
June 6	Hunter pumping plant	1.09		1.09
September 4	do	1.60		1.60
June 9	Johnson & Hubbard pumping plant	.59		.59

Natural flow of return water to Santa Ana River in second-feet, compared with developed water in San Bernardino Valley above Colton, Cal., 1905—Continued.

Date.	Location.	Developed.	Natural.	Total.
		Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*
September 4	Johnson & Hubbard pumying plant	0.30		0.30
June 9	Lamb pumping plant	.30		.30
September 27	do	.00		.00
June 9	Lawson Well Co. pumping plant	.62		.62
September 27	do	.60		.60
June 10	Logsdon & Farrell ditch		0.00	.00
September 2	do		.00	.00
June 10	Lytle Creek Water and Improvement Co	.00		.00
September 27	do	.00		.00
May 30	Merryfield pumping plant	.67		.67
September 28	do	.40		.40
June 2	McKenzie ditch		.00	.00
September 5	do		.00	.00
June 9	Meeks & Daley ditch		15.70	15.70
September 2	do		15.50	15.50
June 16	McIntyre ditch		.00	.00
September 28	do		.00	.00
June 9	Orange Land and Water Co. pumping plant	.00		.00
September 27	do	1.60		1.60
June 16	Riverside Highland Water Co., Lytle Creek	7.05		7.05
September 28	do	8.00		8.00
May 31	Riverside Highland Water Co., Santa Ana River	6.36		6.36
September 4	do	7.60	.40	8.00
June 16	Rancheria pumping plant	1.24		1.24
September 27	do	1.10		1.10
June 2	Rabel ditch		.00	.00
September 5	do		.00	.00
May 31	Riverside Water Co., upper canal	25.33	24.85	50.18
August 31	do	21.20	12.90	34.10
May 31	Riverside Water Co., mill pumping plant	.92		.92
August 31	do	1.30		1.30
May 31	Riverside Water Co., mill flume		2.24	2.24
August 31	do		.00	.00
May 26	Riverside Water Co., flume pump No. 1	3.95		3.95
August 31	do	3.60		3.60
May 26	Riverside Water Co., flume pump No. 2	3.18		3.18
August 31	do	3.00		3.00
June 6	Rosedale Water Co. pumping plant	.30		.30
September 28	do	.00		.00
June 6	Rogers pumping plant		.00	.00
August 31	do	.00		.00
June 2	Shay or Stout Dam ditch		.00	.00
September 5	do		.00	.00
May 31	Swamp ditch		.47	.47
August 14	do		.40	.40
June 6	West Riverside 350-inch Water Co. pumping plant	2.00		2.00
September 28	do	5.60		5.60
June 19	Whitlock ditch		.00	.00
September 2	do		.00	.00
June 6	Whiting ditch		.00	.00
September 4	do		.00	.00
May 31	Ward and Warren ditch	.00		.00
September 4	do		.00	.00

Return waters in San Bernardino Valley below Slover Mountain and above Riverside Narrows, 1905.

[Measurements by K. Sanborn, engineer Riverside Water Company.]

Date.	Location.	Developed.	Natural.	Total.
		Sec.-ft.	*Sec.-ft.*	*Sec.-ft.*
May 27	Alvitrez ditch at headgate, east end of West Riverside Bridge.	.....	3.00	3.00
August 11	.....do	.....	1.30	1.30
June 6	Cuttle's pumping plant	2.50	.....	2.50
October 4	.....do	2.25	.....	2.25
May 27	Evans Island or Jansen ditch, under west end of West Riverside Bridge.	.....	.00	.00
August 11	.....do	.....	.00	.00
May 29	Evans ditch, near Riverside County line	.....	.00	.00
August 11	.....do	.....	.50	.50
May 29	Evans Well ditch, Santa Ana street	.00	.....	.00
August 9	.....do	1.70	.....	1.70
May 30	Evans pipe line to China garden at headworks	.....	.00	.00
August 11	.....do	.....	.00	.00
May 27	Evans pumping plant, 1,000 feet south of west end of West Riverside Bridge.	2.87	.....	2.87
September 5	.....do	4.20	.....	4.20
June 19	Evans Jurupa pumping plant at wier end of main	2.00	.....	2.00
October 4	Evans Jurupa pumping plant	.00	.....	.00
May 30	Ferris Gallagher ditch, near headworks	.....	2.20	2.20
August 14	.....do	.....	2.00	2.00
May 30	Gallagher ditch, near headworks	.....	.00	.00
August 14	.....do	.....	1.20	1.20
May 29	Jurupa pumping plant, to supply Rubidoux ditch	2.10	.....	2.10
August 15	.....do	4.80	.....	4.80
May 30	Lower Canal Riverside Water Co. at flume at headworks.	.....	2.20	2.20
September 5	.....do	.....	.00	.00
June 6	Pond's pumping plant	2.50	.....	2.50
October 4	.....do	2.25	.....	2.25
May 29	Rubidoux ditch at measuring box	.....	4.92	4.92
August 15	.....do	.....	7.20	7.20
June 15	Riverside Power Co. canal at Pedley crossing	.....	30.60	30.60
September 22	.....do	.....	27.00	27.00
June 19	Rivero Land Co. pumping plant	.80	.....	.80
October 4	.....do	.60	.....	.60
May 29	Smith or Evans ditch, 1 mile below Riverside County line.	.....	2.30	2.30
August 14	.....do	.....	.00	.00
May 27	Soquel ditch at intake	.....	3.20	3.20
August 11	.....do	.....	2.70	2.70
May 27	Spring Brook pumping plant at wier end of main	.....	5.58	5.58
August 11	.....do	.....	3.60	3.60
May 29	Spanishtown pumping plant at wier end of main	4.17	.....	4.17
August 11	.....do	2.60	.....	2.60
May 30	Zimmerman pipe line at dam	.....	1.40	1.40
August 14	.....do	.....	1.20	1.20

Discharge measurements of canals between the Riverside Narrows and the Auburndale bridge having their source in the Santa Ana River, 1905.

Date.	Location.	Discharge.
		Sec.-ft.
June 15	Castele ditch near intake	0.00
September 22	do	.00
June 15	Durkee ditch at Auburndale road crossing	4.10
September 22	do	.00
June 15	Fuller ditch at waste gate	5.60
September 22	do	5.40
June 15	Gilliland ditch at Auburndale road crossing	1.40
September 22	do	.30
June 15	Newton ditch near intake	2.30
September 22	do	1.70
June 15	Newberry ditch at Auburndale road crossing	.00
September 22	do	.00
June 15	Roberts or Le Gay ditch near intake Santa Ana River	1.00
September 22	do	1.70
June 15	Wilbur ditch at Rogers pipe trestle crossing Santa Ana River	6.10
September 22	do	6.40
June 15	Santa Ana River, Auburndale Bridge	63.60
Do	Santa Ana River, Auburndale Bridge, including ditches	71.13
September 22	Santa Ana River, Auburndale Bridge	57.00
Do	Santa Ana River, Auburndale Bridge, including ditches	57.80

MISCELLANEOUS MEASUREMENTS IN SANTA ANA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the Santa Ana River drainage basin during 1905:

City Creek near Highlands, Cal.—This stream is a tributary of Santa Ana River. A measurement was made September 23 by W. B. Clapp in diversion canal at mouth of canyon Measurement made over weir.

Discharge, 1.16 second-feet.

Chino Creek near Rincon, Cal.—This stream is a tributary of Santa Ana River. The following measurements were made during 1905 at the wagon bridge at Rincon road crossing, one-fourth mile above junction of Chino Creek with the Santa Ana river.

February 24: Width, 16 feet; area, 22 square feet; mean velocity, 2.09 feet per second; discharge, 46 second-feet.

April 17: Width, 7 feet; area, 5.6 square feet; mean velocity, 4.64 feet per second; discharge, 26 second-feet.

May 16: Width, 5 feet; area, 4 square feet; mean velocity, 4.25 feet per second; discharge, 17 second-feet.

June 6: Width, 4 feet; area, 1.7 square feet; mean velocity, 3.53 feet per second; discharge, 6.0 second-feet.

July 29: Width, 2 feet; area, 0.4 square foot; mean velocity, 2.75 feet per second; discharge, 1.1 second-feet.

September 21: Width, 3 feet; area, 2 square feet; mean velocity, 0.95 foot per second; discharge, 1.9 second-feet.

Cable Canyon Creek near Glen Helen, Cal.—This stream is a tributary of the Santa Ana River. A measurement was made July 13 by K. Sanborn. Measurement made over weir.

Discharge, 1.66 second-feet.

Devil Canyon near Irvington Station, Cal.—This stream is a tributary of the Santa Ana River. A measurement was made July 13 by K. Sanborn at the mouth of the canyon, 100 feet below head of M. L. & W. Co.'s ditch.

Discharge, 1.26 second-feet.

East Twin Creek near Arrowhead Springs, Cal.—This stream is a tributary of the Santa Ana River. A measurement was made September 23 by W. B. Clapp at the mouth of the canyon. Measurement made over weir.

Discharge, 0.54 second-foot.

Lytle Creek near Rialto, Cal.—This stream is one of the principal tributaries of the Santa Ana River. A measurement was made June 16 by K. Sanborn at the head of Fontella Development Company's canal at the mouth of the canyon. Measurement made over weir.

Discharge, 23 second-feet.

Mill Creek near Mentone, Cal.—This stream is one of the principal tributaries of the Santa Ana River. The following measurements were made during 1905:

At road crossing between Mentone and Santa Ana Canyon, April 14: Width, 16 feet; area, 11.2 square feet; mean velocity, 4.11 feet per second; discharge, 46 second-feet. This is waste water and does not include water diverted by Crafton Zanja.

At head of Crafton Zanja, September 23: Width, 7.7 feet; area, 4.7 square feet; mean velocity, 4.33 feet per second; discharge, 20 second-feet.

Morton Canyon Creek near Mentone, Cal.—This stream is a small tributary of Santa Ana River. A measurement was made September 22 by W. B. Clapp at the mouth of the canyon, 500 feet above its junction with Santa Ana River.

Width, 0.8 foot; area, 0.096 square foot; mean velocity, 1.67 feet per second; discharge, 0.16 second-foot.

Plunge Creek near East Highlands, Cal.—This stream is a tributary of the Santa Ana River. The following measurements were made during 1905:

At road crossing Orange avenue between Redlands and Highlands, April 15: Width, 16 feet; area, 5.1 square feet; mean velocity, 1.94 feet per second; discharge, 9.9 second-feet.

At cement ditch at the mouth of the canyon, September 22: Width, 2 feet; area, 0.6 square foot; mean velocity, 1.67 foot per second; discharge, 1.0 second-foot.

Redlands tunnel near Mentone, Cal.—This is developed water from tunnel in the bed of the Santa Ana River at the mouth of the canyon. A measurement was made September 22 over weir at the mouth of the tunnel.

Discharge, 1.1 second-feet.

Santa Ana River near Redlands, Cal.—A measurement of this stream was made at the road crossing at Orange avenue between Redlands and Highlands April 14.

Width, 55 feet; area, 34 square feet; mean velocity, 2.35 feet per second; discharge, 76 second-feet.

Santa Ana River near Rincon, Cal.—The following measurements were made during 1905 at the Rincon wagon bridge, at the lower end of San Bernardino Valley, and the head of the lower Santa Ana Canyon. These measurements, with the addition of those of Chino Creek, show the total discharge of the Santa Ana River below all diversions in San Bernardino Valley, and show the amount of water which is used for irrigation in the vicinity of Orange, Santa Ana, Anaheim, and Fullerton, Cal., diversions being made below this point of measurement.

The gage is a 1 by 4 inch timber, graduated to feet and tenths and bolted to the first caisson from the south end of the Rincon wagon bridge. There is no bench mark.

February 24: Width, 40 feet; area, 68 square feet; mean velocity, 3.01 feet per second; gage height, 3.63 feet; discharge, 205 second-feet.

April 17: Width, 48 feet; area, 68 square feet; mean velocity, 2.53 feet per second; gage height, 3.60 feet; discharge, 172 second-feet.

May 16: Width, 45 feet; area, 50 square feet; mean velocity, 2.30 feet per second; gage height, 3.35 feet; discharge, 115 second-feet.

June 6: Width, 45 feet; area, 44 square feet; mean velocity, 1.98 feet per second; gage height, 3.32 feet; discharge, 87 second-feet.

July 29: Width, 48 feet; area, 34 square feet; mean velocity, 2.06 feet per second; gage height, 3.25 feet; discharge, 70 second-feet.

September 21: Width, 46 feet; area, 39 square feet; mean velocity, 1.95 feet per second; gage height, 3.33 feet; discharge, 76 second-feet.

Waterman Canyon Creek or West Twin Creek, near Arrowhead Springs, Cal.—This stream is a tributary of Santa Ana River. A measurement was made July 13 by K. Sanborn at the bridge on the road to Waterman's ranch at the mouth of the canyon.

Discharge, 1.02 second-feet.

SAN GABRIEL RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The San Gabriel River rises in the Sierra Madre Mountains and, flowing in a southwesterly direction through the San Gabriel and Los Angeles valleys, discharges its waters into the Pacific Ocean near Long Beach, Cal. In the upper reaches of this basin there are numerous tributaries, which have their source in the higher elevations of the Sierra Madre Range. The topography in the upper reaches of this basin is rough and rugged, with deep and narrow canyons, while on the lower elevations the country is rolling, with large areas of valley land. The formation on the higher mountain elevation is of granite, with a light soil covering, with sparse timber growth. As one approaches the middle elevations the covering is brush, with scattering timber, while in the foothill country there is nothing but a growth of grass. The gaging station on this stream is located at a point where the stream leaves the higher mountains in the vicinity of Azusa. Below this point the river enters San Gabriel Valley, where the stream has a comparatively light grade, the bed being composed of bowlders, gravel, and sand, in which the water quickly disappears, except in times of flood discharge. The waters of this stream again appear on the surface at the lower end of San Gabriel Valley, at the discharge from the foothills, where an obstruction to the underground passage forces the water to the surface, on which it flows for a short distance and again disappears in the sands of the flat country below the foothills. The entire flow of this stream during the summer months is diverted at a point about 5 miles above the gaging station and is used for power purposes at the mouth of the canyon. From this point it is carried in ditches and used for irrigation in San Gabriel Valley. The water is again diverted where it appears on the surface at the lower end of this valley and is used for irrigation on the lower levels below this point. The mean precipitation in this basin varies from 15 to 30 inches and is principally in the form of rain. On small areas in the higher mountain elevations the precipitation is in the form of snow, which melts in the early spring months.

SAN GABRIEL RIVER AND CANALS NEAR AZUSA, CAL.

Owing to the numerous diversions, it has been difficult to obtain accurate discharge measurements at Azusa, but during 1898 the San Gabriel Electric Company completed its system, and measurements are now obtained with greater ease and hence with greater accuracy. The headworks of this company are located about 6 miles above the mouth of the canyon. The water is carried around the left side by a series of tunnels and conduits, and a head of 400 feet is obtained where the electric power is generated. Weirs are placed on the conduit of the electric company and the water is measured at this point. The capacity of the conduit is 80 second-feet.

The cable and gage are located about 1 mile from Azusa. During the season of low water for a period of from six to eight months the canals above the station divert the entire flow and there is no running water at the station. The total flow of the river is obtained by adding the daily discharge for the river to the figures for the corresponding dates for the canals.

The channel is straight for 100 feet above and 500 feet below the cable and has a width of 280 feet at high water. At low stages there are two channels having different elevations, and accurate measurements are difficult to obtain. The bed of the stream is composed of cobblestones and bowlders, and the current is swift.

Discharge measurements are made by means of a cable and car. The gage is a vertical staff. During 1905 the gage was read by Don. D. Morgan.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Discharge measurements of San Gabriel River and canals near Azusa, Cal., in 1905.

Date.	Hydrographer.	Gage height.	Discharge.		
			River.	Canal.	Total.
		Feet.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*
February 10	E. C. La Rue	2.20	190	66	256
February 17	do	3.50	560	66	626
March 12	R. S. Hawley	9.30	11,055	72	11,127
March 14	W. B. Clapp	5.30	2,030	70	2,100
March 16	R. S. Hawley	5.80	3,225	80	3,305
March 24	do	4.20	611	54	665
March 31	do	3.80	400	80	480
April 13	do	3.45	262	80	342
April 19	do	3.30	190	80	270
May 2	do	4.12	553	80	633
May 9	do	3.50	288	80	368
June 5	do	2.91	97	80	177
June 23	W. B. Clapp	2.60	41	84	125
July 5	Hawley and Clapp	2.28	17	85	102
November 4	W. B. Clapp	.....	00	30	30

Daily gage height, in feet, of San Gabriel River near Azusa, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	0	0	2.1	[a] 3.8	3.1	2.95	2.4
2	0	2.6	2.1	[a] 3.75	3.7	2.95	2.35
3	0	5.5	2.1	[a] 3.75	3.4	2.95	2.35
4	0	[a] 4.75	2.1	[a] 3.7	3.3	2.9	2.35
5	0	4.0	2.3	[a] 3.7	3.2	2.9	2.25
6	0	3.0	2.3	[a] 3.65	3.2	2.9	2.25
7	0	2.7	1.7	[a] 3.65	3.2	2.85	2.2
8	0	2.5	1.7	[a] 3.6	4.0	2.85	2.15
9	0	2.3	1.65	[a] 3.6	3.6	2.85	2.15
10	0	2.2	1.65	[a] 3.55	3.5	2.8	2.15
11	0	2.0	1.7	[a] 3.55	3.4	2.8	2.55
12	0	1.9	9.3	[a] 3.5	3.4	2.8	2.15
13	0	1.8	[a] 7.3	3.5	3.3	2.8	2.15
14	0	1.8	5.3	3.45	3.3	2.8	2.1
15	0	[a] 3.0	4.7	[a] 3.4	3.3	2.75	2.1
16	0	[a] 3.5	5.8	[a] 3.4	3.3	2.7	2.05
17	0	[a] 3.5	5.1	[a] 3.4	3.3	2.7	2.0
18	0	3.1	4.8	[a] 3.35	3.3	2.7	1.9
19	0	3.0	4.7	3.3	3.3	2.65	1.8
20	0	2.8	4.4	3.3	3.2	2.6	1.5
21	0	2.7	4.3	3.3	3.2	2.6	([b])
22	1.55	2.5	4.2	3.3	3.2	2.6	.....
23	0	2.4	4.2	3.2	3.2	2.6	.....
24	0	2.3	4.2	3.2	3.15	2.6	.....
25	0	2.2	4.2	3.2	3.1	2.55	.....
26	0	2.2	[a] 4.2	3.2	3.1	2.55	.....
27	0	2.2	[a] 4.1	3.1	3.1	2.55	.....
28	0	2.2	[a] 4.0	3.1	3.1	2.5	.....
29	0	.....	4.0	3.1	3.1	2.45	.....
30	0	.....	[a] 3.9	3.05	3.05	2.45	.....
31	0	.....	3.8	.....	3.0	.....	.....

[a] Estimated. [b] Dry from July 21 to December 31.

NOTE.—Gage washed out on March 12; replaced April 19. Gage heights taken with a level between March 12 and April 19.

Station rating table for San Gabriel River near Azusa, Cal., from February 2 to March 11, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	0	2.50	207	3.60	610	4.70	1,620
1.50	55	2.60	231	3.70	670	4.80	1,750
1.60	65	2.70	259	3.80	730	4.90	1,900
1.70	76	2.80	289	3.90	800	5.00	2,050
1.80	88	2.90	320	4.00	870	5.10	2,220
1.90	101	3.00	351	4.10	950	5.20	2,390
2.00	115	3.10	390	4.20	1,040	5.30	2,570
2.10	130	3.20	430	4.30	1,140	5.40	2,750
2.20	147	3.30	470	4.40	1,250	5.50	2,940
2.30	165	3.40	513	4.50	1,370		
2.40	185	3.50	560	4.60	1,490		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during first part of 1905; 1904 table applies from January 1 to February 1, inclusive.

Station rating table for San Gabriel River near Azusa, Cal., from March 12 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	1	3.20	170	4.70	1,040	6.40	4,499
1.80	2.5	3.30	202	4.80	1,160	6.60	4,951
1.90	4.5	3.40	237	4.90	1,300	6.80	5,403
2.00	7	3.50	273	5.00	1,460	7.00	5,855
2.10	10	3.60	311	5.10	1,640	7.20	6,307
2.20	14	3.70	351	5.20	1,830	7.40	6,759
2.30	18	3.80	394	5.30	2,030	7.60	7,211
2.40	24	3.90	441	5.40	2,245	7.80	7,663
2.50	32	4.00	492	5.50	2,470	8.00	8,115
2.60	42	4.10	550	5.60	2,695	8.20	8,567
2.70	55	4.20	616	5.70	2,920	8.40	9,019
2.80	71	4.30	687	5.80	3,145	8.60	9,471
2.90	90	4.40	762	5.90	3,370	8.80	9,923
3.00	113	4.50	841	6.00	3,599	9.00	10,375
3.10	140	4.60	935	6.20	4,047	9.20	10,828

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905.

Daily discharge, in second-feet, of San Gabriel canals near Azusa, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	30	34	67	80	80	80	85	55	34	30	29	50
2	23	67	67	80	80	80	85	54	33	29	29	47
3	21	70	67	80	80	80	86	54	32	28	29	45
4	20	78	67	80	80	80	85	53	33	28	29	44
5	19.5	68	0	80	80	80	85	52	34	28	29	44
6	19	78	67	80	80	80	86	50	35	28	32	42
7	18.5	69	72	80	80	80	86	47	34	28	44	42
8	18.5	86	72	80	48	80	85	46	33	28	95	41
9	41	74	72	80	80	80	85	45	32	27	53	39
10	59	66	72	80	80	80	85	45	32	27	42	37
11	40	66	72	80	80	73	71	46	32	27	38	37
12	35	66	72	80	80	73	74	44	32	27	36	37
13	31	66	0	80	80	76	75	44	32	28	36	38
14	29	66	70	80	80	76	74	43	31	29	34	39
15	27	66	79	80	80	0	74	43	31	29	34	39
16	30	67	80	80	80	78	74	42	30	29	45	39
17	30	66	80	80	80	78	74	41	31	30	53	39
18	28	68	80	80	80	78	74	40	31	30	43	39
19	28	69	79	80	80	78	73	41	30	30	40	38
20	27	68	80	80	80	78	73	41	29	29	42	46
21	55	68	80	80	80	78	70	40	29	29	41	42
22	67	68	78	80	80	88	69	40	28	31	39	39
23	67	68	57	80	80	84	68	39	30	32	38	38
24	57	67	54	80	80	84	67	38	30	31	37	37
25	46	68	69	80	80	84	64	38	30	30	37	38
26	41	67	80	80	80	84	.62	36	29	29	37	38
27	40	67	80	80	80	84	64	36	30	29	97	38
28	38	67	80	80	80	84	62	35	31	28	87	38
29	37	.....	80	80	80	84	60	34	32	28	62	37
30	36	.....	80	80	80	84	68	33	31	29	53	37
31	34	.....	80	.....	80	.....	56	33	.....	28	.....	38

Estimated monthly discharge of San Gabriel River [a] near Azusa, Cal., for 1905.

[Drainage area, 222 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	108	18.5	36.6	2,251	0.165	0.190
February	3,010	34	466	25,880	2.10	2.19
March	11,130	142	1,222	75,140	5.50	6.34
April	474	206	329	19,580	1.48	1.65
May	540	193	278	17,090	1.25	1.44
June	182	63	139	8,271	.626	.698
July	109	56	83.0	5,103	.374	.431
August	55	33	42.8	2,631	.193	.222
September	35	28	31.4	1,869	.141	.157
October	32	27	28.8	1,771	.130	.150
November	97	29	44.7	2,660	.201	.224
December	50	37	40.1	2,466	.181	.209
The year	11,130	18.5	2,284	164,700	1.03	13.90

[a] Includes water in canal.

MISCELLANEOUS MEASUREMENTS IN SAN GABRIEL RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the San Gabriel River drainage basin during 1905:

Baldwin ditch near El Monte, Cal.—This ditch diverts water from the Rio Hondo River and is used for irrigation of land in the vicinity of the Old Mission. A measurement was made October 6 by W. B. Clapp at Old Mission Bridge, 4 miles below El Monte, Cal.

Width, 1.2 feet; area, 1.4 square feet; mean velocity, 2.14 feet per second; discharge, 3.0 second-feet.

Cate ditch near El Monte, Cal.—This ditch diverts water from the San Gabriel River and is used for the irrigation of land in the vicinity of Rivera, Cal. A measurement was made October 6 by W. B. Clapp in flume at road crossing near county road between El Monte and Whittier and about 5 miles below El Monte.

Width, 4 feet; area, 7.7 square feet; mean velocity, 1.45 feet per second; discharge, 11.2 second-feet.

Ranchito or Standerford ditch near El Monte, Cal.—This ditch diverts water from the San Gabriel River and is used for the irrigation of land in the vicinity of Rivera and Downey, Cal. A measurement was made October 6 by W. B. Clapp 25 feet below head-gate and about 5 miles below El Monte, Cal.

Width, 11.8 feet; area, 11 square feet; mean velocity, 1.42 feet per second; discharge, 15.6 second-feet.

Los Nietos or Banta ditch.—This ditch diverts water from the San Gabriel River and is used for the irrigation of land in the vicinity of Los Nietos, Cal. A measurement was made October 6 by W. B. Clapp 100 feet below head-gate of Ranchito ditch.

Width, 18 feet; area, 14.8 square feet; mean velocity, 1.14 feet per second; discharge, 16.8 second-feet.

Rio Hondo near El Monte, Cal.—This stream constitutes one branch of the San Gabriel River. A measurement was made October 6 by W. B. Clapp at Old Mission Bridge, 4 miles below El Monte and below the diversion of the Baldwin ditch.

Width, 13 feet; area, 12 square feet; mean velocity, 1.75 feet per second; discharge, 21 second-feet.

Rincon ditch near El Monte, Cal.—This ditch diverts water from the San Gabriel River 2 miles below Southern Pacific Railroad bridge and is used for irrigation of land in the vicinity of Rincon, Cal. A measurement was made October 6 by W. B. Clapp at road crossing, one-half mile east of the Durfee ranch.

Width, 6 feet; area, 3.2 square feet; mean velocity, 1.06 feet per second; discharge, 3.4 second-feet.

Sheep Creek ditch near El Monte, Cal.—This ditch diverts water from Sheep Creek, a tributary of San Gabriel River. A measurement was made October 6 by W. B. Clapp in flume at road crossing, 1 mile east of Durfee ranch.

Width, 3 feet; area, 2.1 square feet; mean velocity, 2.19 feet per second; discharge, 4.6 second-feet.

Santa Anita Creek near Sierra Madre, Cal.—This stream is a tributary of the San Gabriel River. A measurement was made October 23 by W. B. Clapp at the mouth of the canyon above Baldwin diversion.

Width, 3 feet; area, 1.0 square foot; mean velocity, 1.50 feet per second; discharge, 1.5 second-feet.

San Gabriel River near El Monte, Cal.—A measurement was made of this stream on April 13 by R. S. Hawley at wagon bridge, 2 miles east of El Monte, Cal.

Width, 56 feet; area, 20 square feet; mean velocity, 2.35 feet per second; discharge, 47 second-feet.

LOS ANGELES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Los Angeles River is formed by the Tujunga, Pacoima, and other small creeks which have their source in the Sierra Madre Range of mountains to the northeast of the city of Los Angeles. These streams leave the mountains at a point about 25 miles above the city and enter the comparatively flat country of San Fernando Valley, where, except in times of excessive flood, the waters disappear in the sand and gravel washes of the valley. These waters again make their appearance at the lower end of this valley, where a secondary range of hills, extending from east to west, forces the waters to the surface in what is known as Los Angeles River. Below this point the river discharges through the flat country of Los Angeles Valley, finally entering the Pacific Ocean near the town of Long Beach, Cal. During the summer months the entire flow of Los Angeles River is diverted at a point about 5 miles above Los Angeles for the supply of the city, and only a small amount of water passes this point except during flood discharge of the river. The topography is rough in the upper reaches of this drainage basin, the streams discharging in deep, narrow canyons. In this portion of the drainage basin the formation is of granite, with good soil covering and light timber and heavy brush growth. There is a considerable area of foothill country within this basin, lying between the base of the Sierra Madre Range and Los Angeles Valley, which has a light covering of brush and grass. The soil of San Fernando Valley consists principally of river wash, coarse sand, and gravel, except along the base of the mountains and foothills, where the soil is of good depth and is under a high state of cultivation. The soil of Los Angeles Valley, below the city of Los Angeles, consists of a light sandy loam and is under a high state of cultivation. The mean precipitation throughout this basin is from 15 to 30 inches and falls in the form of rain, except on small areas on the higher mountain elevations.

MISCELLANEOUS MEASUREMENTS IN LOS ANGELES RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Los Angeles River drainage basin during 1905:

Arroyo Seco near Pasadena, Cal.—This stream is a tributary of Los Angeles River. The following measurements were made on this stream during 1905 by W. B. Clapp:

At mouth of canyon, 5 miles above Pasadena, Cal., April 11: Width, 13.5 feet; area, 8.1 square feet; mean velocity, 2.11 feet per second; discharge, 17.1 second-feet.

At Devils Gate, 3 miles above Pasadena, Cal., April 11: Width, 8 feet; area, 8.7 square feet; mean velocity, 1.44 feet per second; discharge, 12.5 second-feet.

At point 1,000 feet above submerged dam of Pasadena Land and Water Company, at Pasadena, Cal., April 11: Width, 8 feet; area, 2 square feet; mean velocity, 1.30 feet per second; discharge, 2.6 second-feet.

At sycamore grove, near Morgan's south line, Los Angeles, Cal., by J. B. Lippincott, October 27: Width, 1.1 feet; area, 0.16 square foot; mean velocity, 0.64 foot per second; discharge, 0.10 second-foot.

At sycamore grove, 600 feet above Morgan's south line, October 27: Width, 1.2 feet; area, 0.20 square foot; mean velocity, 1.14 feet per second; discharge, 0.23 second-foot.

Big Tejunga Creek near Sunland, Cal.—This stream is a tributary of the Los Angeles River. The following measurements were made during 1905 by R. S. Hawley:

At mouth of canyon, 1 mile above Sunland, Cal., April 12: Width, 25 feet; area, 13.7 square feet; mean velocity, 4.45 feet per second; discharge, 61 second-feet.

At Southern Pacific Company's railroad crossing near Pacoima, Cal., April 12: Width, 25 feet; area, 10.3 square feet; mean velocity, 2.82 feet per second; discharge, 29 second-feet.

Two miles below Southern Pacific Railroad bridge at Pacoima, Cal., April 12: No discharge.

Little Tejunga Creek near Sunland, Cal.—This stream is a tributary of Los Angeles River and discharges into Big Tejunga Creek below Sunland. A measurement was made April 11 by R. S. Hawley at mouth of canyon two-thirds of a mile above the junction with Big Tejunga Creek.

Width, 6 feet; area, 1.6 square feet; mean velocity, 2.06 feet per second; discharge, 3.3 second-feet.

Pacoima Creek near Fernando, Cal.—This stream is a tributary of Los Angeles River. The following measurements were made during 1905 by R. S. Hawley:

At mouth of canyon, 5 miles above Fernando, Cal., April 12: Width, 20 feet; area, 7.3 square feet; mean velocity, 4.11 feet per second; discharge, 30 second-feet.

At Southern Pacific Railroad bridge, 1 mile east of Fernando, Cal., April 12: Width, 10 feet; area, 6.2 square feet; mean velocity, 2.84 feet per second; discharge, 17.6 second-feet.

Three miles below Southern Pacific Railroad bridge, near Fernando, Cal., April 12: No discharge.

MISCELLANEOUS MEASUREMENTS ON LOS ANGELES RIVER.

The following measurements were made on Los Angeles River at Los Angeles, Cal., during 1905:

At Fourth Street Bridge.—March 13: Width, 120 feet; area, 446 square feet; mean velocity, 10.15 feet per second; discharge, 4,525 second-feet.

At Huron street.—April 12: Width, 38 feet; area, 20 square feet; mean velocity, 2.15 feet per second; discharge, 43 second-feet.

At Ninth Street Bridge.—April 12: Width, 13 feet; area, 5.8 square feet; mean velocity, 2.19 feet per second; discharge, 12.7 second-feet.

During the summer of 1905 measurements were made to determine the amount of water diverted by the city of Los Angeles for domestic supply and also to determine the amount of water which passes the city's diversion point. The amount of water diverted for the city's supply is shown in measurements made in the 44-inch conduit and the main supply conduit. The amount of water discharging in the river below these points of diversion is shown by measurements made at Huron street. The following measurements were made during 1905 at these points:

Measurements on Los Angeles River in Los Angeles.

Date.	44-inch conduit discharge.	Main supply conduit discharge.	Huron street.			
			Width.	Area.	Mean velocity.	Discharge.
	Sec.-ft.	*Sec.-ft.*	*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*
May 15	42	11	24	7.2	1.47	10.6
June 22	38	9.9	16	3.2	1.03	3.3
July 28	37	8.4	6	2.2	1.77	4.6
September 19	35.3	8.7	6	2.2	1.55	3.4

MALIBU CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Malibu Creek rises in the Santa Monica Mountains and enters the Pacific Ocean about 15 miles above the town of Santa Monica. This stream is formed by Triunfo and Las Virgenes creeks, which drain the northern portion of the Santa Monica Range and the lower foothill country to the north. The formation throughout this basin is shale, sandstone, and conglomerate, with good soil covering. There is a sparse growth of timber on the higher elevations, but a greater portion of this area has a covering of brush and grass used extensively for pasturage, with limited areas of cultivated land for the raising of grain. A reservoir has been constructed on the upper reaches of the Triunfo Creek and the waters are used for irrigation within the basin during the summer months. This reservoir covers an area of about 300 acres when filled.

The mean precipitation in this basin amounts to about 25 inches and falls wholly in the form of rain.

MALIBU CREEK NEAR CALABASAS, CAL.

This station was established November 29, 1901, by S. G. Bennett. It is located at Chapman's ranch, 40 miles from Los Angeles, by wagon road, and 8 miles southwest of Calabasas, about one-fourth mile below the mouth of Las Virgenes Creek.

The channel section is poor and subject to change during high water, but is at the only point where an observer could be secured. The excessive cost of visiting the station has made it impossible to obtain as many meter measurements as desired, but the observer is instructed to take float velocities at various gage heights, and these data, with cross sections and slope, are used in addition to meter measurements for computing discharges for use in constructing rating curves and tables. The estimated discharge is a rough approximation only.

The channel is straight for about 600 feet above the station and curved for about 300 feet below. The current is swift. Both banks are high. The right bank is rocky, and the bed of the stream is composed of rock and gravel.

The initial point for soundings is on the right bank. The gage rod is a vertical staff fastened to an alder tree on the right bank. During 1905 the gage was read by J. G. Chapman. The bench mark is a cross on a small projection on a rock bluff about 10 feet southwest of the gage rod; elevation, 5.43 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Malibu Creek near Calabasas, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 20	R. S. Hawley	9	6.2	1.5	0.9	9.3
May 12	do	9	6.3	1.35	.82	8.5

Daily gage height, in feet, of Malibu Creek near Calabasas, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.2	1.1	1.5	0.8	0.6	0.5	0.5	0.5	0.4	0.45	0.5
2	1.2	1.3	1.1	1.25	.8	.6	.5	.5	.5	.4	.45	.5
3	1.2	1.6	1.1	1.2	.8	.6	.5	.5	.5	.4	.45	.5
4	1.2	2.85	1.1	1.2	.8	.6	.5	.5	.5	.4	.45	.5
5	1.2	1.85	1.1	1.2	.8	.6	.5	.5	.5	.4	.55	.5
6	1.2	2.1	1.1	1.25	.8	.6	.5	.5	.5	.4	.55	.5
7	1.2	1.3	1.1	1.25	1.3	.6	.5	.5	.5	.4	.55	.5
8	1.2	1.2	1.1	1.25	.9	.6	.5	.5	.5	.4	.55	.5
9	1.2	1.15	1.1	1.2	.9	.6	.6	.5	.5	.4	.55	.5
10	1.2	1.15	1.1	1.2	.9	.6	.6	.5	.5	.4	.55	.6
11	1.2	1.15	1.0	1.2	.9	.6	.6	.5	.45	.4	.55	.6
12	1.2	1.15	7.6	1.1	.9	.6	.6	.5	.45	.4	.6	.6
13	1.2	1.15	4.2	1.25	.9	.6	.6	.5	.45	.4	.6	.6
14	1.2	1.1	3.25	1.0	.7	.6	.6	.5	.45	.4	.6	.6
15	1.2	1.1	3.25	1.0	.7	.6	.6	.5	.45	.4	.6	.6
16	1.2	1.8	4.75	1.0	.7	.6	.6	.5	.45	.4	.6	.6
17	1.2	1.65	3.55	1.0	.7	.6	.6	.5	.45	.4	.6	.6
18	1.2	1.55	2.8	.9	.7	.6	.6	.5	.4	.4	.6	.6
19	1.22	1.4	2.5	.9	.7	.6	.6	.5	.4	.4	.6	.6
20	1.25	1.3	2.4	.9	.7	.6	.6	.5	.4	.4	.6	.6
21	1.3	1.2	2.4	.9	.7	.6	.6	.5	.4	.4	.6	.6
22	1.24	1.2	2.3	.9	.7	.6	.6	.5	.4	.4	.6	.6
23	1.2	1.15	2.2	.9	.7	.6	.5	.5	.45	.4	.6	.6
24	1.2	1.1	2.2	.9	.7	.6	.5	.5	.45	.4	.6	.6
25	1.2	1.1	1.0	.9	.7	.5	.5	.5	.45	.4	.6	.6
26	1.2	1.1	1.6	.9	.7	.5	.5	.5	.45	.4	.5	.6
27	1.2	1.1	1.45	.9	.7	.5	.5	.5	.45	.4	.5	.6
28	1.2	1.1	1.55	.8	.6	.5	.5	.5	.45	.4	.5	.6
29	1.2	.....	1.7	.8	.6	.5	.5	.5	.45	.45	.5	.6
30	1.2	.....	1.7	.8	.6	.5	.5	.5	.45	.45	.5	.6
31	1.2	.....	1.55	.....	.6	.....	.5	.5	.....	.45	.....	.6

Estimated monthly discharge of Malibu Creek near Calabasas, Cal., for 1905.

[Drainage area, 97 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	10	5	5.4	332	0.056	0.065
February	560	2	36.1	2,005	.372	.387
March	6,800	1	484.	29,760	4.99	5.75
April	41	8	14.4	857	.148	.165
May	24	4	7.3	449	.075	.086
June	4	3	3.8	226	.039	.044
July	3	3	3.0	184	.031	.036
August	3	3	3.0	184	.031	.036
September	3	1	2.1	125	.022	.024
October	2	1	1.1	68	.011	.013
November	4	2	3.6	214	.037	.041
December	4	3	3.7	228	.038	.044
The year	6,800	1	47.3	34,630	.488	6.69

NOTE.—The estimated monthly discharge is only an approximation.

TRIUNFO CREEK NEAR CALABASAS, CAL.

This station is located 8 miles southwest of Calabasas, Cal., about one-half mile above the mouth of Las Virgenes Creek.

The channel section is poor and subject to change during high water, but is at the only point where an observer could be secured. The excessive cost of visiting the station has made it impossible to obtain as many meter measurements as desired, but the observer is instructed to take float velocities during floods at various gage heights, and these data, with cross sections and grade of stream, are used in addition to meter measurements for computing discharges for use in constructing rating curves and tables. The estimated discharge from this stream is a rough approximation only.

The channel is straight for about 400 feet above and 800 feet below the station, and the water is swift. Both banks are high and rocky. The bed of the stream is composed of gravel and sand and is shifting.

The initial point for soundings is on the right bank. The gage rod is a vertical staff bolted to rock cliff on right bank. During 1905 the gage was read by J. G. Chapman. The bench mark is a cross on a point of rock 3.5 feet above the bed of the creek on the right bank; elevation, 4.53 feet above the datum of the gage.

Information in regard to this section is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Triunfo Creek near Calabasas, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 20	R. S. Hawley	15	7.1	1.13	1.60	8.0
May 12	do	17	6.3	1.13	1.44	7.1

Daily gage height, in feet, of Triunfo Creek near Calabasas, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	.....	0.00	0.5	1.3	.....	1.3	1.0
2	.....	.75	.5	1.5	.....	1.3	1.1
3	.....	.9	.5	1.5	.....	1.3	1.1
4	.....	2.15	.5	1.5	.....	1.3	1.1
5	.....	1.65	.5	1.5	.....	1.3	1.1
6	.....	2.2	.5	1.5	.....	1.3	1.1
7	.....	1.65	.5	1.6	1.4	1.3	1.1
8	.....	1.0	.5	1.6	.8	1.3	1.1
9	.....	.9	.5	1.6	.4	1.3	1.2
10	.....	.7	.45	1.5	.....	1.3	1.2
11	.....	.55	.45	1.55	.....	1.25	1.2
12	.....	.5	6.0	1.5	.....	1.25	1.2
13	.....	.5	2.55	1.5	.....	1.25	1.2
14	.....	.3	2.15	1.5	1.2	1.25	1.2
15	.....	.3	2.05	1.5	1.2	1.25	1.2
16	.....	1.65	3.3	1.5	1.2	1.25	1.2
17	.....	1.45	3.1	1.5	1.2	1.25	1.2
18	.....	1.3	2.6	1.5	1.2	1.2	1.2
19	.....	1.2	2.25	1.4	1.2	1.2	1.2
20	.....	1.1	1.2	1.4	1.2	1.2	1.2
21	.....	.9	1.2	1.4	1.2	1.2	1.2
22	.....	.85	1.2	1.4	1.2	1.2	1.2
23	.....	.8	1.1	.....	1.2	1.2	1.1
24	.....	.8	2.2	.....	1.2	1.2	1.1
25	.....	.7	1.6	.....	1.2	1.0	1.1
26	.....	.7	1.4	.....	1.3	1.0	1.1
27	.....	.7	1.4	.....	1.3	1.0	1.1
28	.....	.6	1.3	.....	1.3	1.0	1.1
29	.....	.....	1.4	.....	1.3	1.0	1.1
30	.....	.....	1.4	.....	1.3	1.0	1.0
31	.....	.....	1.4	.....	1.3	.....	0.0

NOTE.—Creek dry Jan 2 to Feb. 1, Apr. 23 to May 6, May 10–13, Aug. 1 to Dec. 31.

Estimated monthly discharge of Triunfo Creek near Calabasas, Cal., for 1905.

[Drainage area, 72 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	0	0	0.0	0	0.0	0.0
February	410	0	26.2	1,455	.364	.379
March	5,000	1	353.0	21,700	4.90	5.65
April	40	0	11.2	666	.156	.174
May	6	0	1.0	61	.014	.016
June	2	1	1.3	77	.018	.020
July	1	0	.97	60	.013	.015
August	0	0	.0	0	.0	.0
September	0	0	.0	0	.0	.0
October	0	0	.0	0	.0	.0
November	0	0	.0	0	.0	.0
December	0	0	.0	0	.0	.0
The year	5,000	0	32.8	24,020	.455	6.25

NOTE.—The estimated monthly discharge is only an approximation.

SANTA CLARA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Santa Clara River rises in the Coast Range in the northwestern part of Los Angeles County and flows in a westerly direction, discharging its waters into the Pacific Ocean near Ventura, Cal. It has numerous tributaries from the north, all of which are torrential in their character, having a heavy discharge during the winter months. This stream has a comparatively flat grade, flowing over a sandy and gravelly bed, into which it sinks during a greater portion of the year. At numerous points along its course the water rises to the surface during the summer and flows for a short distance, again disappearing in the sand. At points where the waters make their appearance on the surface numerous diversions are made for irrigation along the valley, where the soil is deep and is under the highest state of cultivation, this being especially the case on the lower reaches of the river below the town of Santa Paula. The principal tributaries of this stream are Piru Creek, Sespe Creek, and Santa Paula Creek, all of which produce a very heavy flood discharge of short duration during the rainy season, but during the summer months have a light discharge. On the upper reaches of the principal tributaries of this stream the topography is rough and broken, the streams discharging through deep canyons. This is especially noticeable on the Sespe Creek. On the upper reaches of the main stream the country is rolling and has a sparse covering of timber with a considerable growth of brush and grass, and is used extensively for pasturage. The formation is of shale, sandstone, and conglomerate throughout the entire basin. The precipitation is extremely light in the upper reaches of this basin, but increases on the lower reaches nearer the Pacific Ocean and falls in the form of rain.

MISCELLANEOUS MEASUREMENTS IN SANTA CLARA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the Santa Clara River drainage basin during 1905:

Camulos ditch near Camulos, Cal.—This ditch diverts water from the Santa Clara River 1 mile above Camulos, Cal. The water is used for the irrigation of land at Camulos. A measurement was made October 19 by W. B. Clapp in a flume about 1,000 feet below the head of the canal.

Width, 3.5 feet; area, 3.5 square feet; mean velocity, 2.17 feet per second; discharge, 7.6 second-feet.

Farmers' canal near Santa Paula, Cal.—This canal diverts water from the Santa Clara River at a point 1 mile above Santa Paula, Cal. The water is used for irrigation of land between Santa Paula and Saticoy, Cal. A measurement was made October 21 by W. B. Clapp in flume 200 feet below where canal crosses Santa Clara River, about 1 mile above the town of Santa Paula, Cal.

Width, 4 feet; area, 4.8 square feet; mean velocity, 1.50 feet per second; discharge, 7.2 second-feet.

Grees ditch near Santa Paula, Cal.—This ditch diverts water from the Santa Clara River about 1 mile above the town of Santa Paula, Cal. The water is used for the irrigation of land between Santa Paula and Saticoy. A measurement was made on October 21 by W. B. Clapp at a point 200 feet below head of ditch and about 1 mile above the town of Santa Paula, Cal.

Width, 8 feet; area, 6.6 square feet; mean velocity, 1.39 feet per second; discharge, 9.2 second-feet.

Piru Land and Water Company's upper diversion near Esperanza, Cal.—This water is diverted from Piru Creek for domestic and irrigation purposes in the town of Piru, Cal. A measurement was made October 20 by W. B. Clapp at point of diversion at head of pipe line, 1 mile above the town of Esperanza, Cal.

Width, 5 feet; area, 1.5 square feet; mean velocity, 0.93 foot per second; discharge, 1.4 second-feet.

Piru Creek near Esperanza, Cal.—This stream is a tributary of the Santa Clara River. A measurement was made October 20 by W. B. Clapp at point 1 mile above Esperanza, Cal., and below the upper diversion of the Piru Land and Water Company.

Width, 8 feet; area, 2.4 square feet; mean velocity, 1.42 feet per second; discharge, 3.4 second-feet. For total flow of Piru Creek at this point add upper diversion of Piru Land and Water Company.

Piru Creek near Piru City, Cal.—A measurement was made October 20 by W. B. Clapp 1 mile above Piru City and above lower diversion of Piru Land and Water Company.

Width, 8 feet; area, 2.8 square feet; mean velocity, 1.90 feet per second; discharge, 5.3 second-feet. This measurement shows total flow of Piru Creek at this point and includes the discharge of Piru Creek 1 mile above Esperanza, Cal. The increase is caused by seepage water along the creek.

Sespe Land and Water Company's canal near Sespe, Cal.—This canal diverts water from Sespe Creek and is used for irrigation of land in the vicinity of Sespe. A measurement was made October 20 by W. B. Clapp one-half mile below head of canal.

Width, 5.2 feet; area, 4.5 square feet; mean velocity, 1.47 feet per second; discharge, 6.6 second-feet.

Sespe Creek near Sespe, Cal.—This creek is a tributary of the Santa Clara River. A measurement was made October 20 by W. B. Clapp one-half mile below heading of Sespe Land and Water Company's canal.

Width, 4 feet; area, 2.9 square feet; mean velocity, 1.66 feet per second; discharge, 4.8 second-feet. For total flow of Sespe Creek add discharge of Sespe Land and Water Company's canal as shown by measurement made on this date.

San Francisquito Creek near Saugus, Cal.—This creek is a tributary of the Santa Clara River. A measurement was made October 19 by W. B. Clapp at road crossing near Newhall ranch, 3½ miles below Saugus, Cal., and 500 feet above junction with Santa Clara River

Width, 5 feet; area, 2.8 square feet; mean velocity, 0.46 foot per second; discharge, 1.3 second-feet.

Santa Paula Creek near Santa Paula, Cal.—This stream is a tributary of the Santa Clara River. A measurement was made October 21 by W. B. Clapp 3 miles above Santa Paula and above diversion of the Santa Paula Land and Water Company.

Width, 11 feet; area, 5.6 square feet; mean velocity, 0.88 foot per second; discharge, 4.9 second-feet. This measurement shows total discharge of Santa Paula Creek on this date.

Santa Clara River near Saugus, Cal.—A measurement was made October 19 by W. B. Clapp at road crossing near Newhall ranch, 3½ miles below Saugus, Cal.

Width, 6 feet; area, 3.8 square feet; mean velocity, 1.39 feet per second; discharge, 5.3 second-feet.

Santa Clara River near Camulos, Cal.—A measurement was made October 19 by W. B. Clapp at a point 1 mile above Camulos and 1,000 feet below diversion of Camulos ditch.

Width, 11 feet; area, 4.9 square feet; mean velocity, 2.06 feet per second; discharge, 10.1 second-feet. For total discharge of Santa Clara River at this point add discharge of Camulos ditch.

Santa Clara River near Santa Paula, Cal.—A measurement was made October 21 by W. B. Clapp 1 mile above Santa Paula and about 500 feet below diversion of Farmers and Grees canals.

Width, 33 feet; area, 17.4 square feet; mean velocity, 1.55 feet per second; discharge, 27 second-feet. For total diversion of Santa Clara River at this point add discharge of Farmers and Grees canals.

Santa Clara River near Saticoy, Cal.—A measurement was made October 21 by W. B. Clapp at a point opposite Saticoy and 200 feet below head of Santa Clara Water and Irrigation Company's canal.

Width, 14 feet; area, 14.7 square feet; mean velocity, 1.63 feet per second; discharge, 24 second-feet. For total discharge of Santa Clara River at this point add discharge of Santa Clara Water and Irrigation Company's canal.

Santa Clara Water and Irrigation Company's canal near Saticoy, Cal.—This canal diverts water from the Santa Clara River and is used for the irrigation of Santa Clara ranch near Oxnard, Cal.

Measurement made over weir. Discharge equals 16.7 second-feet.

SANTA YNEZ RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Santa Ynez River rises in the mountains of Santa Barbara and Ventura counties and flows westerly with a flat grade to the Pacific Ocean, having a length of approximately 75 miles. The Santa Ynez Range of mountains, varying in elevation from 3,000 to 4,000 feet, forms the southern boundary of this drainage basin. The northern divide ranges from 4,500 to 5,500 feet in elevation, culminating in Mount Pinos, the elevation of which is 8,826 feet. The northern part of the watershed is drained by streams running in a southerly direction and uniting with the Santa Ynez River proper, which runs close to the northerly base of the Santa Ynez Mountains, flowing westerly and paralleling the Coast Range. The principal tributary, Mono Creek, enters from the north.

The formation throughout the entire drainage basin consists chiefly of shale and sandstone, the strike being parallel to the coast and the dip nearly vertical, inclining somewhat to the south.

The greater portion of the drainage is sparsely covered with brush and small trees, only a small area on the higher elevations having any considerable growth of timber.

The mean annual precipitation is estimated at 25 inches for the entire area and falls almost entirely in the form of rain.

There are several reservoir sites on Santa Ynez and its tributaries which have been surveyed.

SANTA YNEZ RIVER NEAR SANTA BARBARA, CAL.

The original station, at which measurements were made during the greater part of 1903, was located about 1 mile above the mouth of Mono Creek. On November 1, 1903, the old station was abandoned and a new station established by L. M. Hyde. It is located at the Gibraltar dam site, 5 miles below the original station, and is below the mouth of Mono Creek. It is 9 miles above the San Marcus ranch and halfway between the old quicksilver mines.

The channel is straight for 700 feet above and 600 feet below the station. The right bank is low, but is not liable to overflow. The left bank rises abruptly about 20 feet beyond the tree to which the cable is attached. It is not liable to overflow. The bed of the stream is composed of sand and gravel, free from vegetation and bowlders. The cross section is regular and is permanent. The current is swift.

Discharge measurements are made at high water by means of a cable. Measurements can can usually be made by wading. The initial point for soundings is a blaze at the base of the cottonwood tree on the right bank, to which the cable is attached.

The gage is an inclined timber spiked to a cottonwood tree on the right bank. The tree is blazed and graduated above the gage rod for recording stages above the gage. The bench mark is a cross on a bench of a ledge of rock on the left bank, about 100 feet below the cable. Elevation, 13.54 feet above the datum of the gage. The approximate elevation above sea level, as estimated from topographic maps, is 1,200 feet.

Information in regard to this station is contained in Water Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Daily gage height, in feet, of Santa Ynez River near Santa Barbara, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.5	3.1	3.25	2.65	2.4	2.05	2.0	1.9	1.8	1.8	2.05
2	2.3	3.6	3.05	3.25	2.7	2.4	2.05	2.0	1.9	1.8	1.8	2.05
3	2.25	8.4	3.0	3.2	2.65	2.4	2.05	2.0	1.85	1.8	1.8	2.05
4	2.25	6.8	3.0	3.15	2.6	2.4	2.05	2.0	1.85	1.8	1.8	2.05
5	2.25	4.0	3.05	3.15	2.6	2.4	2.05	2.0	1.85	1.8	1.8	2.05
6	2.25	3.9	3.1	3.1	2.6	2.4	2.05	2.0	1.85	1.8	1.85	2.05
7	2.2	3.75	3.0	3.1	2.6	2.4	2.05	2.0	1.85	1.8	1.85	2.05
8	3.8	3.7	2.9	3.05	2.6	2.4	2.05	2.0	1.85	1.8	1.85	2.05
9	3.7	3.65	2.9	3.05	2.6	2.35	2.05	2.0	1.85	1.8	1.85	2.05
10	2.6	3.65	2.85	3.05	2.6	2.35	2.05	2.0	1.85	1.8	1.85	2.05
11	2.55	3.6	2.9	3.0	2.6	2.35	2.05	2.0	1.85	1.8	1.85	2.05
12	2.5	3.6	4.7	3.05	2.6	2.3	2.05	2.0	1.85	1.8	1.9	2.05
13	2.45	3.6	8.9	3.0	2.55	2.3	2.05	2.0	1.85	1.8	1.9	2.05
14	2.4	3.55	5.65	2.95	2.55	2.25	2.05	2.0	1.85	1.8	1.9	2.05
15	2.45	3.4	4.65	2.95	2.55	2.25	2.05	2.0	1.85	1.8	1.9	2.05
16	2.5	4.45	5.3	2.9	2.55	2.2	2.05	1.95	1.85	1.8	1.9	2.05
17	2.45	6.55	4.65	2.9	2.55	2.2	2.05	1.95	1.85	1.8	1.9	2.05
18	2.4	4.0	4.4	2.9	2.5	2.2	2.05	1.95	1.85	1.8	1.9	2.05
19	2.4	3.75	4.15	2.85	2.5	2.15	2.05	1.95	1.85	1.8	1.9	2.05
20	2.4	3.7	4.0	2.85	2.5	2.15	2.05	1.95	1.85	1.8	1.9	2.05
21	4.25	3.65	3.8	2.85	2.5	2.15	2.05	1.95	1.85	1.8	1.9	2.05
22	3.15	3.5	3.75	2.8	2.5	2.1	2.05	1.95	1.85	1.8	1.9	2.05
23	2.9	3.4	3.65	2.8	2.5	2.1	2.05	1.95	1.8	1.8	1.9	2.05
24	2.8	3.3	3.6	2.8	2.5	2.1	2.05	1.9	1.8	1.8	1.9	2.05
25	2.75	3.2	3.55	2.75	2.45	2.1	2.05	1.9	1.8	1.8	1.9	2.05
26	2.65	3.15	3.5	2.75	2.45	2.1	2.0	1.9	1.8	1.8	2.0	2.05
27	2.65	3.1	3.4	2.85	2.45	2.1	2.0	1.9	1.8	1.8	2.1	2.05
28	2.6	3.1	3.4	2.75	2.45	2.1	2.0	1.9	1.8	1.8	2.1	2.05
29	2.6	.....	3.6	2.7	2.45	2.1	2.0	1.9	1.8	1.8	2.1	2.05
30	2.5	.....	3.4	2.7	2.45	2.1	2.0	1.9	1.8	1.8	2.05	2.05
31	2.5	.....	3.3	.....	2.45	.....	2.0	1.9	.....	1.8	.....	2.05

Station rating table for Santa Ynez River near Santa Barbara, Cal., from January 1 to February 2, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	0.4	2.60	38	3.20	154	3.80	401
2.10	2.8	2.70	50	3.30	186	3.90	451
2.20	6.4	2.80	65	3.40	222	4.00	502
2.30	11.6	2.90	82	3.50	263		
2.40	18.5	3.00	103	3.60	306		
2.50	28	3.10	126	3.70	353		

Station rating table for Santa Ynez River near Santa Barbara, Cal., from February 3 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	1	3.00	153	4.20	875	5.80	2,790
1.90	2	3.10	184	4.30	965	6.00	3,070
2.00	3	3.20	220	4.40	1,065	6.20	3,360
2.10	5	3.30	265	4.50	1,175	6.40	3,650
2.20	10	3.40	315	4.60	1,285	6.60	3,940
2.30	19	3.50	370	4.70	1,395	6.80	4.230
2.40	30	3.60	430	4.80	1,510	7.00	4,520
2.50	44	3.70	495	4.90	1,630	7.50	5,245
2.60	60	3.80	565	5.00	1,750	8.00	5,970
2.70	79	3.90	635	5.20	1,990	8.50	6,695
2.80	100	4.00	710	5.40	2,250	9.00	7,420
2.90	125	4.10	790	5.60	2,510		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during January, February, and March, 1906.

Estimated monthly discharge of Santa Ynez River near Santa Barbara, Cal., for 1905.

[Drainage area, 207 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	635	6.4	73.8	4,538	0.357	0.412
February	6,550	28.0	905	50,260	4.37	4.55
March	7,275	112	797	49,010	3.85	4.44
April	242	79	143	8,509	.691	.771
May	100	37	52.5	3,228	.254	.293
June	30	5	15.9	946	.077	.086
July	4	3	3.8	234	.018	.021
August	3	2	2.6	160	.013	.015
September	2	1	1.4	83	.0068	.0076
October	1	1	1.0	61	.0048	.0055
November	5	1	2.1	125	.010	.011
December	4	4	4.0	246	.019	.022
The year	7,275	1.0	167	117,400	.806	10.63

SANTA MARIA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Santa Maria River drains the northern slope of the San Rafael Mountains and a limited area of foothill country to the north of this range. It flows in a westerly direction, finally discharging its waters into the Pacific Ocean at Guadalupe about 25 miles south of San Luis Obispo. Its flow is torrential in character, subject to floods of short duration during the rainy period, but being practically dry during the summer months. It has numerous tributaries, the most important of which is the Sisquoc, which enters it about 12 miles above the town of Santa Maria. The gaging station is located about 25 miles above the town of Santa Maria and above most of its important tributaries. The country throughout this basin consists of rolling foothills, with the exception of the higher elevations of the San Rafael Mountains, which reach an elevation of 6,000 to 8,000 feet. The river breaks from the foothills at the point where it is joined by the Sisquoc and flows through the flat country of the Santa Maria Valley for a distance of about 25 miles until it joins the Pacific Ocean at Guadalupe. The formation throughout this basin is of shale, sandstone, and conglomerate, with a good covering of heavy clay soil. There is considerable growth of timber on the higher elevations of the San Rafael Mountains, but over most of the area the growth of timber is light, with large areas of brush and grass. The pasturage of stock is carried on extensively throughout the basin. There are no diversions along this stream for irrigation although tunnel work has been attempted above Santa Maria for the development of underground water, with poor results. There are numerous wells in the vicinity of Santa Maria which produce considerable water for the irrigation of land in that locality, the soil being very deep and of exceptional quality, susceptible to the highest state of cultivation. The mean precipitation in this drainage basin is probably about 25 inches. The greatest rainfall occurs on the lower elevations near the coast. The higher elevations receive some snowfall, which melts early in the spring and does not tend to keep up the flow of the stream through the summer.

SANTA MARIA RIVER NEAR SANTA MARIA, CAL.

This station was established October 22, 1903, by W. B. Clapp. It is located near the ranch house on Dutard's ranch, 21 miles above Santa Maria, Cal., a station on the Pacific Coast Railway. It is reached by driving from Santa Maria.

The channel is slightly curved for 300 feet above and curved for 1,000 feet below the station. The water is swift at medium and flood stages.

The right bank is high and rocky, and not liable to overflow. The left bank is low, covered with scattering poplar trees, but not liable to overflow. The bed of the stream is composed of sand and gravel. A portion of the bed is covered with a light growth of low brush. The channel is not liable to much change.

At low and medium water discharge measurements are made with meter by wading. During high water velocities are measured by means of floats. For this purpose two wires are stretched across the stream 254 feet apart. The rise in the channel above the upper wire is 0.40 foot in 100 feet, and below the upper wire it is 0.57 foot in 100 feet. The initial points for soundings are blazes on the poplar trees on the left bank, to which the wires are attached.

The gage is an inclined staff, fastened to a rock ledge at the right bank. During 1905 the gage was read once each day by James A. Thompson. The bench mark is a spike driven near the ground into the south side of the poplar tree to which the upper wire is fastened on the left bank of the stream; elevation, 9.65 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Santa Maria River near Santa Maria, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 2	E. C. La Rue	34	30	2.67	3.30	80
March 6	O. W. Peterson	24	22	2.14	2.70	47
March 21	do	40	28	2.39	1.20	67

Daily gage height, in feet, of Santa Maria River near Santa Maria, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	2.6	2.05	0.9	0.8	0.65	0.7	0.6	0.5	0.6	0.75	0.85
2	3.0	3.8	2.05	.9	1.1	.65	.7	.6	.5	.6	.75	.85
3	2.9	6.0	2.05	.9	1.0	.7	.7	.6	.5	.6	.75	.85
4	2.7	5.95	2.05	.9	.85	.7	.7	.6	.5	.65	.75	.8
5	2.7	5.0	2.05	.9	.8	.7	.7	.6	.5	.65	.75	.8
6	2.7	5.0	2.7	.9	.8	.7	.7	.6	.5	.65	.75	.8
7	2.7	3.5	2.65	.85	.8	.7	.7	.6	.5	.65	.75	.8
8	2.7	3.2	2.5	.85	1.2	.7	.7	.6	.5	.65	.75	.8
9	2.7	3.0	2.35	.85	1.25	.7	.7	.6	.5	.65	.75	.8
10	2.7	2.9	2.2	.85	1.0	.7	.7	.6	.5	.65	.75	.8
11	2.7	2.85	2.2	.85	.9	.7	.7	.6	.5	.65	.75	.8
12	2.65	2.8	2.2	.85	.9	.7	.7	.6	.5	.65	.75	.8
13	2.65	2.75	10.0	.85	.85	.7	.7	.6	.5	.65	.75	.8
14	2.65	2.75	[a] 5.0	.85	.85	.7	.7	.6	.5	.65	.75	.8
15	2.65	2.65	[a] 4.5	.85	.8	.7	.7	.6	.5	.65	.75	.8
16	2.7	3.0	[a] 4.0	.85	.8	.7	.7	.6	.5	.7	.75	.8
17	2.65	4.1	[a] 4.0	.85	.8	.7	.65	.6	.5	.7	.75	.8
18	2.65	5.95	[a] 3.5	.85	.8	.7	.65	.6	.5	.7	.75	.8
19	2.65	4.0	[a] 3.5	.85	.8	.7	.65	.6	.5	.7	.75	.85
20	2.65	2.6	[a] 2.0	.85	.8	.7	.65	.6	.5	.7	.75	.85
21	3.0	2.4	1.2	.85	.8	.7	.65	.6	.5	.7	.75	.85
22	2.8	2.35	1.1	.85	.75	.7	.65	.6	.5	.7	.75	.85
23	2.7	2.25	1.05	.85	.75	.7	.65	.6	.5	.7	.75	.85
24	2.7	2.15	1.05	.85	.7	.7	.65	.6	.5	.7	.75	.85
25	2.65	2.15	1.0	.85	.65	.7	.65	.55	.7	.75	.75	.85
26	2.65	2.15	1.0	.85	.6	.7	.65	.55	.7	.75	.75	.8
27	2.65	2.1	1.0	.85	.6	.7	.65	.55	.65	.75	.75	.8
28	2.65	2.05	1.2	.85	.6	.7	.65	.55	.6	.75	.85	.8
29	2.65	.....	1.2	.8	.6	.7	.65	.5	.6	.75	.85	.85
30	2.6	.....	1.1	.8	.65	.7	.6	.5	.6	.75	.85	.85
31	2.6	.....	1.0	.....	.65	.....	.6	.5	.....	.75	.....	.85

[a] Estimated.

Station rating table for Santa Maria River near Santa Maria, Cal., from January 1 to February 2, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	1	2.60	13	3.20	67	3.70	178
2.10	2	2.70	18	3.30	82	3.80	213
2.20	3	2.80	25	3.40	100	3.90	250
2.30	5	2.90	33	3.50	122	4.00	290
2.40	7	3.00	43	3.60	148	4.10	330
2.50	10	3.10	54				

Station rating table for Santa Maria River near Santa Maria, Cal., from February 3 to March 12, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	1	2.70	48	3.70	285	4.70	915
1.80	2	2.80	59	3.80	335	4.80	990
1.90	3	2.90	72	3.90	385	4.90	1,065
2.00	5	3.00	87	4.00	440	5.00	1,140
2.10	8	3.10	105	4.10	500	5.20	1,290
2.20	12	3.20	125	4.20	565	5.40	1,440
2.30	17	3.30	147	4.30	630	5.60	1,595
2.40	23	3.40	173	4.40	700	5.80	1,755
2.50	30	3.50	205	4.50	770	6.00	1,915
2.60	38	3.60	242	4.60	840		

Stationrating table for Santa Maria River near Santa Maria, Cal., from March 13 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.50	1	2.00	250	4.00	1,070	7.00	3,260
0.60	3	2.10	280	4.20	1,185	7.20	3,450
0.70	6	2.20	310	4.40	1,305	7.40	3,650
0.80	10	2.30	340	4.60	1,435	7.60	3,870
0.90	18	2.40	375	4.80	1,565	7.80	4,100
1.00	31	2.50	410	5.00	1,700	8.00	4,350
1.10	47	2.60	445	5.20	1,840	8.20	4,640
1.20	65	2.70	480	5.40	1,980	8.40	4,970
1.30	84	2.80	520	5.60	2,130	8.60	5,340
1.40	105	2.90	560	5.80	2,280	8.80	5,750
1.50	127	3.00	600	6.00	2,430	9.00	6,200
1.60	150	3.20	690	6.20	2,585	10.00	10,000
1.70	175	3.40	780	6.40	2,745		
1.80	200	3.60	875	6.60	2,910		
1.90	225	3.80	975	6.80	3,080		

NOTE.—The upper part of the rating curve is based on slope measurements.

Estimated monthly discharge of Santa Maria River near Santa Maria, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	122	13	22.5	1,384
February	1,915	6	361	20,050
March	10,000	6	574	35,290
April	18	10	14.5	863
May	74	3	15.5	953
June	6	4	5.9	352
July	6	3	5.0	307
August	3	1	2.7	166
September	6	1	1.6	96
October	8	3	5.4	332
November	14	8	8.6	512
December	14	10	11.7	719
The year	10,000	1	85.7	61,020

NOTE.—Estimates during high-water periods are approximate only.

SALINAS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Arroyo Seco is the most northern tributary of any size of the Salinas River, and rises on the slopes of the highest portion of the Santa Lucia Range, one of the ranges that go to make up the Coast Range of California extending in a general southeast direction from San Francisco Bay. The upper valleys of this stream are far back in the range, surrounded by high mountains.

The drainage area of the Arroyo Seco is almost entirely made up of sharp ridges and V-shaped canyons. The western portion is well covered with brush and trees of medium size. Toward the east this growth decreases until at the Salinas Valley the country is bare. The stream beds of this area fall rapidly, the Arroyo Seco rising at an elevation of nearly 6,000 feet and discharging into the Salinas at an elevation of 170 feet.

Below the gaging station several canals divert water from this stream before it reaches the broad wash of sand and gravel on the flat floor of the Salinas Valley, into which it sinks during the dry season and from which it receives its name "Arroyo Seco."

There are five reservoir sites on the stream and its tributaries, of more or less value as possible storage reservoirs, that have already been surveyed.

This portion of the range undoubtedly receives as great rainfall as any other locality in this region, and it is estimated that the average annual precipitation is from 30 to 50 inches and falls almost entirely in the form of rain.

ARROYO SECO NEAR SOLEDAD, CAL.

The original gaging station on this stream was established by W. W. Cockins, jr., in December, 1900, at Foster's ranch, near Piney, Cal. High water of January, 1901, enlarged an old side channel, dividing the stream into two channels. The gaging station was then removed to Pettitt's ranch, 4 miles below the old station.

The channel is straight for 400 feet above and below the station. The right bank is low, wooded, and subject to overflow. The left bank is high, rocky, and not subject to overflow. The bed of the stream is composed of gravel and is not subject to much change.

Discharge measurements are made by means of a cable and car. The initial point for soundings is on the left bank.

The gage rod is in two sections. The low-water section is placed 400 feet above the cable on the right bank; the high-water section is fastened to a sycamore tree above the cable and about 250 feet from the right bank of the low-water channel. During 1905 the gage was read by Mrs. Charles Pettitt. The bench mark is a spike in the tree to which the high-water section of the gage is fastened; elevation, 15.00 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Discharge measurements of Arroyo Seco River near Soledad, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 31	La Rue and Pettitt	122	123	1.04	5.91	128
February 2	Charles Pettitt	130	410	3.84	8.80	1,574
February 3	do	124	281	3.05	7.50	856
February 5	do	125	254	3.06	7.35	778
February 16	do	125	212	2.29	6.82	486
February 17	do	133	423	4.32	8.95	1,829
March 11	do	120	135	1.05	5.90	142
March 13	do	133	484	4.65	10.05	2,253
March 16	do	128	327	4.02	8.00	1,315
March 17	do	128	288	2.91	7.50	838
March 19	do	133	455	4.90	9.30	2,233
March 29	do	125	248	2.36	7.05	585
April 9	do	123	158	1.57	6.10	248
April 16	do	123	150	1.40	6.09	210
April 19	do	123	151	1.59	6.16	240
April 29	do	122	117	1.07	5.95	125
May 7	do	130	351	3.75	8.30	1,317
May 8	do	125	241	2.86	7.12	689
May 28	do	123	107	1.15	5.93	123
June 4	do	123	113	1.03	5.83	116
June 12	do	122	95	.82	5.75	78
June 18	do	122	89	.76	5.70	68
Do	do	48	63	1.24	5.70	78
June 24	do	43	54	1.00	5.62	54
July 3	do	41	49	.80	5.55	39
July 9	do	40	46	.61	5.48	28
July 15	do	38	42	.57	5.45	24
July 23	do	35	39	.54	5.42	21
July 29	do	36	37	.43	5.40	16
August 6	do	34	35	.37	5.38	13
August 10	do	27	24	.33	5.33	8

Daily gage height, in feet, of Arroyo Seco River near Soledad, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.1	8.4	6.15	6.5	5.9	5.85	5.6	5.4	5.2	5.25	5.35	5.65
2	5.9	8.6	6.1	6.45	6.55	5.85	5.55	5.4	5.2	5.25	5.35	5.6
3	5.8	7.45	6.05	6.4	6.2	5.8	5.5	5.4	5.2	5.25	5.35	5.55
4	5.75	7.4	6.0	6.35	6.05	5.85	5.5	5.4	5.2	5.25	5.35	5.5
5	5.7	7.35	6.0	6.3	6.0	5.8	5.5	5.4	5.2	5.25	5.35	5.5
6	5.7	7.2	6.0	6.25	6.0	5.8	5.5	5.4	5.2	5.25	5.35	5.5
7	5.65	7.0	5.95	6.25	7.9	5.8	5.5	5.35	5.2	5.25	5.35	5.5
8	5.6	6.8	5.9	6.2	7.2	5.8	5.5	5.35	5.2	5.25	5.35	5.5
9	5.8	6.65	5.9	6.1	6.8	5.8	5.5	5.35	5.2	5.25	5.35	5.5
10	6.0	6.55	5.9	6.15	6.6	5.8	5.5	5.35	5.2	5.25	5.35	5.5
11	5.9	6.45	5.9	6.1	6.45	5.75	5.45	5.35	5.2	5.25	5.35	5.5
12	5.8	6.35	6.55	6.1	6.4	5.75	5.45	5.35	5.2	5.25	5.35	5.5
13	5.8	6.3	10.1	6.1	6.3	5.7	5.45	5.35	5.2	5.25	5.35	5.5
14	5.9	6.25	7.85	6.1	6.2	5.7	5.45	5.35	5.2	5.25	5.35	5.5
15	5.9	6.2	7.5	6.05	6.2	5.7	5.45	5.35	5.2	5.25	5.35	5.5
16	6.95	6.8	8.0	6.1	6.15	5.7	5.45	5.3	5.25	5.25	5.35	5.5
17	6.3	8.5	7.6	6.05	6.1	5.7	5.45	5.3	5.25	5.3	5.4	5.5
18	6.1	7.45	7.3	6.0	6.1	5.7	5.45	5.3	5.25	5.3	5.4	5.55
19	6.2	7.05	9.1	6.2	6.05	5.7	5.45	5.3	5.25	5.3	5.4	5.6
20	6.1	6.9	7.6	6.1	6.05	5.7	5.4	5.3	5.2	5.3	5.4	5.6
21	6.5	6.6	7.35	6.05	6.0	5.7	5.4	5.3	5.2	5.3	5.4	5.6
22	6.2	6.5	7.1	6.05	6.0	5.65	5.4	5.3	5.2	5.3	5.4	5.6
23	6.1	6.4	6.9	6.0	5.95	5.65	5.4	5.3	5.2	5.35	5.4	5.6
24	6.05	6.35	6.75	6.0	5.9	5.65	5.4	5.3	5.2	5.35	5.5	5.55
25	6.1	6.3	6.7	6.0	5.9	5.6	5.4	5.3	5.2	5.35	5.65	5.55
26	6.0	6.25	6.65	6.0	5.95	5.6	5.4	5.3	5.2	5.35	5.5	5.5
27	6.0	6.2	6.55	6.0	5.95	5.6	5.4	5.25	5.2	5.35	5.5	5.5
28	6.0	6.2	6.5	6.0	5.95	5.6	5.4	5.25	5.2	5.35	5.75	5.5
29	5.95	.....	7.5	5.95	5.9	5.6	5.4	5.25	5.2	5.35	5.6	5.55
30	5.9	.....	6.65	5.95	5.9	5.6	5.4	5.25	5.2	5.35	5.9	5.5
31	5.9	.....	6.6	.....	5.85	.....	5.4	5.25	.....	5.3	.....	5.5

Station rating table for Arroyo Seco River near Soledad, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.20	2	6.30	265	7.40	800	9.00	1,900
5.30	6	6.40	305	7.50	860	9.20	2,060
5.40	15	6.50	345	7.60	920	9.40	2,225
5.50	30	6.60	390	7.70	980	9.60	2,400
5.60	50	6.70	435	7.80	1,045	9.80	2,580
5.70	70	6.80	480	7.90	1,110	10.00	2,760
5.80	95	6.90	530	8.00	1,175	10.20	2,945
5.90	125	7.00	580	8.20	1,310	10.40	3,135
6.00	155	7.10	635	8.40	1,450		
6.10	190	7.20	690	8.60	1,595		
6.20	225	7.30	745	8.80	1,745		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 31 discharge measurements made during 1905. It is well defined between gage heights 5.3 feet and 9.5 feet.

Estimated monthly discharge of Arroyo Seco River near Soledad, Cal., for 1905

[Drainage area, 215 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	555	50	160	9,838	0.744	0.858
February	1,595	225	556	30,880	2.59	2.70
March	2,850	125	586	36,030	2.73	3.15
April	345	140	202	12,020	.940	1.05
May	1,110	110	246	15,130	1.14	1.31
June	110	50	75.6	4,499	.352	.393
July	50	15	22.8	1,402	.106	.122
August	15	4	8.6	529	.040	.046
September	4	2	2.3	137	.011	.012
October	10	4	6.1	375	.028	.032
November	125	10	22.4	1,333	.104	.116
December	60	30	36.5	2,245	.170	.196
The year	2,850	2	160	114,400	.746	9.98

MISCELLANEOUS MEASUREMENTS IN SOUTHERN CALIFORNIA.

The following is a list of miscellaneous discharge measurements made in Riverside and San Diego counties during 1905:

Cottonwood Creek near Jamul, Cal.—This stream rises in the Coast Range in the southeastern part of San Diego County, and flowing in a southwesterly direction discharges into Tiajuana River below the California-Mexico boundary line. The following discharge measurements were made at the Barrett Dam. The gage is a 2-by-4 inch vertical timber painted white and graduated to feet and hundredths. It is nailed to the timber wall on the left bank of the stream at the concrete dam. No bench mark was established, as the zero of the rod is set level with the top of the concrete dam.

November 18: Width, 2.7 feet; area, 0.5 square foot; mean velocity, 1.00 foot per second; discharge, 0.5 second-foot.

December 14: Width, 5 feet; area, 1.6 square feet; mean velocity, 0.69 foot per second; gage height, 0.05 foot; discharge, 1.1 second-feet.

Temecula Creek near Temecula, Cal.—This creek rises in the Coast Range in the southeastern part of Riverside County, and flowing in a southwesterly direction discharges into the Pacific Ocean near Oceanside, Cal. The following discharge measurements were made on this stream during 1905:

At Pauba dam site, 12 miles above Temecula, Cal., November 14: Width, 7.5 feet; area, 2 square feet; mean velocity, 1.25 feet per second; discharge, 2.5 second-feet.

At Temecula Bridge, 1 mile below Temecula, Cal., November 14: Width, 11 feet; area, 5.4 square feet; mean velocity, 1.07 feet per second; gage height, 3.10 feet; discharge, 5.8 second-feet.

December 30: Width, 9 feet; area, 3.5 square feet; mean velocity, 1.32 feet per second; gage height, 2.98 feet; discharge, 4.6 second-feet.

A gage was placed on the Temecula Bridge consisting of a 2-by-6 inch vertical timber, graduated to feet and hundredths. It is fastened to the downstream pier near the right bank of the stream. No bench mark was established.

San Diego River near Lakeside, Cal.—This stream rises in the Coast Range in the eastern part of San Diego County, and flowing in a southwesterly direction discharges in the Pacific Ocean near San Diego, Cal. A measurement was made at the concrete dam of the San Diego Flume Company, at the head of that company's flume.

November 23: Width, 6 feet; area, 1.0 square foot; mean velocity, 1.90 feet per second; discharge, 1.9 second-feet.

Santa Ysabel River near San Pasqual, Cal.—This stream rises in the eastern part of San Diego County, and flowing in a southwesterly direction discharges into the Pacific Ocean near Del Mar, Cal. The lower portion of this river is known as the San Dieguito River. The following measurements were made during 1905 at the upper end of the San Pasqual Valley. The gage consists of a 2-by-4 inch inclined timber, graduated to feet and hundredths, and bolted to a large granite bowlder on the left bank of the stream. The bench mark is on top of the bowlder to which the gage is bolted. It is marked with a circle of white paint. Its elevation is 11.66 feet above the zero of the gage.

November 21: Width, 5 feet; area, 2.2 square feet; mean velocity, 2.05 feet per second; discharge, 4.5 second-feet.

November 28: Width, 83 feet; area, 24 square feet; mean velocity, 1.70 feet per second; gage height, 3.72 feet; discharge, 41 second-feet.

December 21: Width, 24 feet; area, 7.2 square feet; mean velocity, 1.44 feet per second; gage height, 3.55 feet; discharge, 10.4 second-feet.

Sweetwater River near Descanso, Cal.—This stream rises in the southeastern part of San Diego County, and flowing in a southwesterly direction discharges into San Diego Bay near National City. The following measurements were made during 1905, 1 mile below Descanso. The gage is a 2-by-6 inch vertical timber, graduated to feet and hundredths. It is bolted to a granite bowlder on the left bank of the stream. The bench mark is the highest point on the large bowlder to which the gage is fastened. It is marked with a circle of white paint, and its elevation is 5 feet above the zero of the gage.

September 11: Measured by Weir; discharge, 0.37 second-foot.

November 21: Width, 3 feet; area, 0.9 square foot; mean velocity, 1.22 feet per second; gage height, 3.54 feet; discharge, 1.1 second-feet.

December 10: Width, 6 feet; area, 1.9 square feet; mean velocity, 1.35 feet per second; gage height, 3.62 feet; discharge, 2.5 second-feet.

SAN FRANCISCO BAY DRAINAGE BASIN.

GENERAL FEATURES.

Sacramento River, rising in northern California and flowing south, and San Joaquin River, rising in the southern Sierras and flowing north, drain the western slope of the Sierra Nevada and the eastern slope of the Coast Range north of San Francisco. They meet near Suisun Bay, finally discharging their waters into the Pacific Ocean through San Francisco Bay.

SACRAMENTO RIVER.

DESCRIPTION OF RIVER.

Sacramento River is the principal river of California, and drains all of the territory south of Mount Shasta and between the Coast Range and Trinity Range on the west and the Sierra Nevadas on the east. The portion of the drainage basin above the gaging station which is located near Red Bluff, Cal., extends from the Trinity Mountains on the west to Warner Mountains near the California-Nevada State line on the east. The watershed on the west from the Trinity Mountains is comparatively narrow, being only from 10 to 35 miles in width, and furnishes a very small proportion of the discharge of this river, but from the east Pit River, which is the most important tributary, drains a large area extending about 120 miles east from the Sacramento River and between Mount Shasta on the north and Lassen Peak on the south. The greater portion of this basin is composed of lava, and shows other evidences of volcanic activity, such as volcanic cones and craters. Nearly all the streams tributary to Pit River have their origin in large springs, many of which discharge several hundred second-feet. The most important tributary of the Pit is the McCloud

River, draining the southeastern slope of Mount Shasta. It derives its waters principally from the melting of the snow on the high elevations of this mountain. The western portion of the watershed extending along the Trinity Range is well timbered, as is also that portion of the drainage area in the Sierra Nevadas lying between Mount Shasta and Lassen Peak. Farther east, however, there is little or no forest covering, and the country is used extensively for pasturage. The rainfall is very unequally distributed, varying from less than 10 inches in the eastern portion of the basin to 50 inches along the northern and western portion. Below the gaging station the river enters the Sacramento Valley, through which it flows on a comparatively light grade until it reaches Suisun Bay. During the winter months, when the Sacramento and its tributaries are in flood, large areas of the Sacramento Valley are overflowed. The floods which occur in the latter part of the rainy season, and after these large overflow areas or basins are filled, cause great damage in the lower portion of the valley.

SACRAMENTO RIVER NEAR RED BLUFF, CAL.

The gaging station at Jellys Ferry, which is located about 12 miles above the town of Red Bluff, was established April 30, 1895. The right bank of the river is high, but the left bank is liable to overflow when the river rises above the 25-foot mark. The river has been known to reach the 35-foot mark. Because of the liability to overflow it was deemed advisable to select a new gaging station, where the water at flood stage could be more confined. A point in Iron Canyon, where the river had been gaged by the State engineering department in 1879 and by commissioner of public works in 1893–94, was chosen as a new gaging station.

The river at this point in lower portion of Iron Canyon, 4 miles above Red Bluff, has a direct course for 2 or 3 miles. The width between banks at low water is about 500 feet. The depth of water at low stages averages 6 feet, with a maximum depth of 9 feet. The banks are steep and firm. The river flows in a bed of coarse gravel and cobbles, with here and there a small bowlder. The bed rock is lava.

Discharge measurements are made from a cable 600 feet in span, which is anchored in the lava rock which forms the wall of the canyon.

The river stage rod used by commissioner of public works was still in place, and has been used in making river height observations since January 28, 1902, the date upon which the observations were begun. A second set of gage rods were placed on the right bank 3,200 feet below the gaging station January 1, 1904, as no observer could be obtained to continue readings of the station gage. By synchronous readings of the lower gages and the station gage the actual readings for this lower gage have been converted into equivalent readings for the station gage. On September 28, 1904, it was necessary to move the lower gage rods to the left bank about 4,000 feet below the gaging station. The actual readings of this set of gage rods have also been converted into equivalent readings for the station gage. During 1905 the gage was read twice each day by Fred Weeks. All reported gage heights are those determined for the station gage. Bench marks were established as follows: (1) A nail in the crotch of sycamore tree to which the third section of the gage is fastened; elevation, 8.355 feet. (2) Point of rock marked with heavy ring of white paint 7.1 feet south of eye-bolt on left bank; elevation, 47.75 feet. (3) A point marked with ring of white paint 45 feet north of 10-foot mark on cable; elevation 38.01 feet. (4) Eye-bolt on left bank; elevation 44.80 feet. (5) Point on rock under left cable support marked with circle of white paint; elevation, 27.59 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Discharge measurements of Sacramento River near Red Bluff, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 5	Peterson and Lee	448	3,520	1.48	1.49	5,208
August 30	C. H. Lee	497	3,404	1.48	1.34	5,043

Daily gage height, in feet, of Sacramento River near Red Bluff, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.2	8.9	4.85	8.05	4.05	3.0	1.95	1.45	1.25	1.3	1.3	1.75
2	6.15	15.85	4.75	7.8	4.3	3.0	1.95	1.45	1.25	1.3	1.3	1.55
3	4.8	13.3	4.6	7.55	4.1	3.0	1.9	1.45	1.25	1.3	1.3	1.55
4	4.7	11.35	4.55	7.1	3.9	3.0	1.9	1.45	1.25	1.25	1.3	1.55
5	4.3	10.15	4.5	6.8	3.7	3.0	1.9	1.45	1.25	1.25	1.3	1.55
6	4.0	8.95	4.4	6.45	3.7	3.0	1.8	1.45	1.25	1.25	1.4	1.55
7	3.75	8.15	4.3	6.25	4.1	2.85	1.75	1.4	1.25	1.3	1.4	1.55
8	3.55	7.4	4.2	5.95	5.5	2.9	1.7	1.4	1.25	1.3	1.4	1.55
9	3.45	6.8	4.15	5.75	4.95	2.85	1.75	1.4	1.25	1.3	1.4	1.55
10	3.35	6.4	4.05	5.45	4.6	2.85	1.75	1.4	1.25	1.3	1.4	1.55
11	3.2	6.0	4.05	5.25	3.85	2.7	1.7	1.4	1.25	1.3	1.4	1.55
12	3.1	5.55	4.9	5.0	4.15	2.7	1.7	1.3	1.25	1.3	1.45	1.55
13	3.85	5.2	10.25	4.85	4.15	2.65	1.7	1.3	1.25	1.25	1.45	1.7
14	14.35	4.9	13.55	4.75	3.9	2.6	1.7	1.3	1.25	1.3	1.45	1.55
15	9.8	4.75	11.15	4.7	3.85	2.55	1.7	1.3	1.25	1.3	1.45	1.55
16	9.5	4.55	10.7	5.45	3.85	2.5	1.7	1.3	1.25	1.3	1.45	1.55
17	7.95	4.55	9.7	4.95	4.0	2.4	1.7	1.3	1.25	1.3	1.45	1.7
18	6.85	4.5	8.25	4.75	3.85	2.35	1.6	1.3	1.25	1.3	1.45	1.8
19	7.3	5.25	11.4	5.2	3.75	2.35	1.6	1.3	1.25	1.3	1.45	2.1
20	7.05	8.2	10.3	5.0	3.6	2.3	1.55	1.3	1.25	1.3	1.55	2.1
21	9.2	7.95	11.1	4.85	3.5	2.3	1.55	1.3	1.25	1.3	1.55	1.9
22	14.3	7.2	11.2	4.7	3.4	2.25	1.55	1.3	1.25	1.3	1.55	1.7
23	20.3	6.6	9.0	4.55	3.35	2.25	1.55	1.3	1.25	1.3	1.55	1.55
24	15.55	6.0	9.8	4.4	3.3	2.2	1.5	1.3	1.25	1.3	1.55	1.55
25	15.45	5.7	8.45	4.4	3.2	2.25	1.5	1.25	1.25	1.3	1.55	1.55
26	12.75	5.45	9.0	4.4	3.2	2.2	1.45	1.25	1.25	1.3	1.55	1.55
27	9.8	5.3	8.9	4.3	3.2	2.1	1.45	1.25	1.25	1.3	1.6	1.7
28	8.95	5.0	8.2	4.15	3.2	2.0	1.45	1.25	1.3	1.3	1.7	1.7
29	7.5	.....	15.5	4.05	3.2	2.0	1.45	1.25	1.3	1.3	1.8	1.9
30	6.85	.....	9.85	4.0	3.15	1.95	1.45	1.25	1.3	1.3	1.95	1.8
31	6.55	.....	8.7	.....	3.05	.....	1.45	1.25	.....	1.3	.....	1.9

Station rating table for Sacramento River near Red Bluff, Cal., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	4,450	3.10	10,380	5.40	18,700	9.60	37,180
1.10	4,690	3.20	10,710	5.60	19,500	9.80	38,140
1.20	4,930	3.30	11,040	5.80	20,300	10.00	39,100
1.30	5,170	3.40	11,370	6.00	21,100	10.50	41,600
1.40	5,410	3.50	11,700	6.20	21,940	11.00	44,200
1.50	5,650	3.60	12,040	6.40	22,780	11.50	46,900
1.60	5,920	3.70	12,380	6.60	23,620	12.00	49,700
1.70	6,190	3.80	12,720	6.80	24,460	12.50	52,600
1.80	6,460	3.90	13,060	7.00	25,300	13.00	55,600
1.90	6,730	4.00	13,400	7.20	26,180	13.50	58,600
2.00	7,000	4.10	13,760	7.40	27,060	14.00	61,700
2.10	7,300	4.20	14,120	7.60	27,940	14.50	64,900
2.20	7,600	4.30	14,480	7.80	28,820	15.00	68,200
2.30	7,900	4.40	14,840	8.00	29,700	16.00	75,100
2.40	8,200	4.50	15,200	8.20	30,620	17.00	82,200
2.50	8,500	4.60	15,580	8.40	31,540	18.00	89,700
2.60	8,810	4.70	15,960	8.60	32,460	19.00	97,600
2.70	9,120	4.80	16,340	8.80	33,380	20.00	105,900
2.80	9,430	4.90	16,720	9.00	34,300		
2.90	9,740	5.00	17,100	9.20	35,260		
3.00	10,050	5.20	17,900	9.40	36,220		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is fairly well defined.

Estimated monthly discharge of Sacramento River near Red Bluff, Cal., for 1905.

[Drainage area, 9,295 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	108,500	10,380	31,830	1,957,000	3.42	3.94
February	74,050	15,200	26,800	1,488,000	2.88	3.00
March	71,600	13,580	30,920	1,901,000	3.33	3.84
April	29,930	13,400	18,680	1,112,000	2.01	2.24
May	19,100	10,220	12,750	784,000	1.37	1.58
June	10,050	6,865	8,623	513,100	.928	1.04
July	6,865	5,530	6,075	373,500	.654	.754
August	5,530	5,050	5,251	322,900	.565	.651
September	5,170	5,050	5,062	301,200	.545	.608
October	5,170	5,050	5,155	317,000	.555	.640
November	6,865	5,170	5,616	334,200	.604	.674
December	7,300	5,785	6,100	375,100	.656	.756
The year	108,500	5,050	13,570	9,779,000	1.46	19.7[illegible]

SACRAMENTO RIVER AT SACRAMENTO, CAL.

The following gage heights were observed at this station during 1905:

Daily gage height, in feet, of Sacramento River at Sacramento, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	18.5	20.9	19.7	21.8	19.6	17.4	11.4
2	18.0	21.6	19.7	21.8	19.8	17.3	11.2
3	17.7	21.8	19.6	21.7	19.6	17.2	11.0
4	18.1	21.8	19.5	21.7	19.6	17.0	10.9
5	18.4	21.9	19.5	21.6	19.0	16.9	10.8
6	18.4	22.0	19.4	21.5	18.9	16.4	10.7
7	18.2	21.9	19.3	21.5	19.0	16.3	10.6
8	18.1	21.9	19.0	21.5	19.0	16.2	10.5
9	18.0	21.8	18.8	21.6	19.0	16.1	10.4
10	17.8	21.8	18.7	21.6	19.3	16.0	10.3
11	17.5	21.6	18.2	21.2	18.9	16.0	10.0
12	17.1	21.4	18.1	21.0	18.8	16.0	9.9
13	16.7	21.2	18.0	20.9	18.5	15.9	9.8
14	16.7	20.9	18.9	20.8	18.5	15.8	9.7
15	17.4	20.8	18.9	20.7	18.6	15.4	9.7
16	18.0	20.5	19.0	20.6	18.8	15.1	9.6
17	18.2	20.4	19.2	20.6	19.3	15.0	9.5
18	18.5	20.4	19.4	20.2	18.9	14.7	9.4
19	18.8	20.4	20.1	20.4	18.9	14.5	9.3
20	19.0	20.4	21.0	20.3	18.9	14.0	9.2
21	19.0	20.4	20.8	20.2	18.8	13.8	9.1
22	20.0	20.2	21.1	20.0	18.8	13.6	9.0
23	20.5	20.1	21.0	19.9	18.6	13.3	8.9
24	20.2	20.0	21.2	19.8	18.5	13.0	8.8
25	20.4	20.0	21.2	19.7	18.0	12.7	8.7
26	20.5	20.0	21.3	19.8	17.9	12.4	8.6
27	20.7	20.0	21.7	20.1	18.0	12.0	8.4
28	20.8	19.9	21.6	20.0	17.9	11.9	8.2
29	20.8	.....	21.8	19.9	17.8	11.8	8.2
30	20.9	.....	21.8	19.8	17.7	11.6	.....
31	20.9	.....	21.9	.....	17.5	.....	.....

MISCELLANEOUS MEASUREMENTS IN SACRAMENTO RIVER DRAINAGE BASIN.

Sacramento River at Baird Station, on Southern Pacific Railway, Gregory post-office, Cal.—A measurement of this stream was made August 28, 1905, from wagon bridge by W. B. Clapp.

Width, 116 feet; area, 308 square feet; mean velocity, 1.14 feet per second; discharge, 352 second-feet.

Clear Creek near Stella post-office, Cal.—A measurement was made of this stream August 26, 1905, 500 feet above mouth of Brandy Creek by W. B. Clapp.

Width, 28 feet; area, 31 square feet; mean velocity, 1.26 feet per second; discharge, 39 second-feet.

North Fork Cottonwood Creek near Gas Point, Cal.—A measurement of this stream was made August 28, 1905, 40 feet below the highway bridge above the junction of the North and Middle forks by C. H. Lee. Several diversions are made above the point of measurement; their total discharge is reported to be about 8 second-feet.

Width, 15.5 feet; area, 9.0 square feet; mean velocity, 0.66 foot per second; discharge, 5.9 second-feet.

Middle Fork Cottonwood Creek near Gas Point, Cal.—A measurement of this stream was made August 28, 1905, 300 feet above its junction with the North Fork by C. H. Lee. Three small diversions are made above the point of measurement.

Width, 35 feet; area, 11.3 square feet; mean velocity, 0.81 foot per second; discharge, 9.1 second-feet.

Pit River near Copper City, Cal.—This stream is the largest tributary of the Sacramento River, joining it about 11 miles north of Redding, Cal. It has a well-sustained summer flow. A measurement of this stream was made August 25, 1905, by C. H. Lee from the downstream side of the Delamar Mining Company's toll bridge above the mouth of Squaw Creek.

Width, 135 feet; area, 465 square feet; mean velocity, 6.68 feet per second; discharge, 3,107 second-feet.

Squaw Creek near Copper City, Cal.—A measurement of this stream was made 500 feet below bridge near Copper City by C. H. Lee on August 26, 1905.

Width, 39 feet; area, 95 square feet; mean velocity, 0.21 foot per second; discharge, 20 second-feet.

Cow Creek (above Clover Creek) at Millville, Cal.—A measurement of this stream was made August 26, 1905, at the highway bridge south of Millville by C. H. Lee.

Width, 39.2 feet; area, 35 square feet; mean velocity, 1.75 feet per second; discharge, 61 second-feet.

Clover Creek at Millville, Cal.—A measurement of this stream was made August 26, 1905, about 500 feet below the highway bridge above its junction with Cow Creek by C. H. Lee.

Width, 15 feet; area, 7.8 square feet; mean velocity, 0.40 foot per second; discharge, 3.1 second-feet.

Clover Creek ditch.—A measurement of this ditch was made on August 27, 1905, in flume at its heading, 3 miles above Millville by C. H. Lee.

Width, 2.15 feet; area, 1.8 square feet; mean velocity, 1.33 feet per second; discharge, 2.4 second-feet. This water is diverted from Clover Creek.

Little Cow Creek near Palocedro, Cal.—A measurement of this stream was made on August 27, 1905, 800 feet downstream from the highway bridge east of Palocedro by C. H. Lee. There are several small diversions from this stream above this point.

Width, 11.2 feet; area, 9.0 square feet; mean velocity, 0.50 foot per second; discharge, 4.5 second-feet.

Cow Creek near Palocedro, Cal.—A measurement of this stream was made August 27, 1905, 150 feet below its junction with Little Cow Creek by C. H. Lee.

Width, 41.5 feet; area, 58 square feet; mean velocity, 1.05 feet per second; discharge, 61 second-feet.

Battle Creek near Balls Ferry, Cal.—This stream is an important tributary of the Sacramento River. A measurement was made August 29, 1905, at a point about 2 miles above the wagon bridge on main road from Red Bluff to Balls Ferry by C. H. Lee.

Width, 88 feet; area, 171 square feet; mean velocity, 1.92 feet per second; discharge, 329 second-feet.

Mill ditch near Balls Ferry, Cal.—This ditch heads in Battle Creek 1½ miles above the wagon bridge on the main road from Red Bluff to Balls Ferry. A measurement was made August 29, 1905, 1½ miles below head of ditch, by C. H. Lee.

Width, 22 feet; area, 19.3 square feet; mean velocity, 1.33 feet per second; discharge, 26 second-feet.

Antelope Creek near Red Bluff, Cal.—A measurement of this stream was made August 31, 1905, 600 feet above the Antelope Creek and Red Bluff Water Company's dam, about 8 miles east of Red Bluff, by C. H. Lee.

Width, 36 feet; area, 83 square feet; mean velocity, 0.54 foot per second; discharge, 45 second-feet.

Mill Creek near Tehama, Cal.—A measurement of this stream was made September 1, 1905, 300 feet above the head-gate of the Los Molinas ditch and about 6 miles east of Tehama, by C. H. Lee.

Width, 40.2 feet; area, 91 square feet; mean velocity, 1.34 feet per second; discharge, 122 second-feet.

Millrace canal near Tehama, Cal.—This canal diverts water from Mill Creek about 1½ miles above its junction with Sacramento River. A measurement was made in flume at head of canal September 1, 1905, by C. H. Lee.

Width, 11.8 feet; area, 40 square feet; mean velocity, 2.25 feet per second; discharge, 90 second-feet.

Deer Creek near Vina, Cal.—A measurement of this stream was made September 1, 1905, from the downstream side of the bridge at upper main road crossing, about 4 miles from Vina, by C. H. Lee. Two or three small ditches divert water from creek above this point of measurement.

Width, 57.7 feet; area, 77 square feet; mean velocity, 1.08 feet per second; discharge, 83 second-feet.

Valley Counties Power Company's canal near Centerville, Cal.—This canal diverts water from Butte Creek. A measurement was made May 19 in flume at town of Centerville.

Width, 6 feet; area, 13.2 square feet; mean velocity, 1.74 feet per second; discharge, 23 second-feet.

PIT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Pit River has its source in the Warner Mountains in the extreme northeast part of California. It flows in a southwesterly direction, discharging its waters into Sacramento River a few miles above Redding, Cal. It has numerous tributaries, the larger of which have their source in large springs, which discharge from crevices in the lava formation. About 50 per cent of the area of this drainage basin is barren of timber and composed, principally, of lava with a light soil covering, being used extensively for pasturage and the raising of stock. There are numerous small valleys with light grades, which hold the water throughout the summer months principally in the state of swamps. These areas are used, mainly, as meadow land and for the raising of stock feed. Pit River does not discharge in any great volume until it reaches a point near Fall River Mills, which lies about midway between the point where the Pit River enters the Sacramento and its source. Fall River, which is the principal tributary of the Pit from the north, receives its water supply from large perennial springs which discharge 1,500 second-feet. Hat Creek and Burney Creek are also large tributaries from the south and drain the northern slope of Lassen Peak. Their principal sources are also from large perennial springs in the lava formation.

West Valley Creek is a tributary of South Fork of Pit River. Ash Creek flows into Clear Creek, through which it enters Pit River from the south. There is considerable timber scattered throughout this drainage basin, the principal growth lying in the southern portion of the basin and also in that section lying north of Pit River and between Fall River and the upper Sacramento. There are numerous reservoir sites on the upper reaches of this stream, all of which have been or are being surveyed. Several gaging stations are maintained on Pit River and tributaries at points where surveys have been made for the construction of storage reservoirs. The rainfall throughout this basin is very unevenly distributed, ranging from 10 inches in the eastern portion to 50 to 75 inches in the western and northwestern portion. About 50 per cent of the precipitation falls in the form of snow, but does not remain any length of time except on the higher elevation of Mount Shasta and Lassen Peak.

McCloud River drains the southeastern slope of Mount Shasta. Its drainage area is comparatively small, covering 676 square miles. It is long and narrow, extending from north to south. There are few tributaries. Its main water supply comes from Mount Shasta, on which the snow remains during the entire year. It is also fed by numerous large springs scattered throughout the drainage basin. The precipitation is very heavy and is principally in the form of rain, except on the higher elevations of Mount Shasta. The discharge of this stream seldom falls below 1,200 second-feet. It discharges into the Pit River a few miles above the junction of the Pit with the Sacramento. The entire basin is well timbered.

PIT RIVER NEAR CANBY, CAL.

This station was established December 26, 1903, by H. E. Green and J. S. Evans. It is located at the wagon bridge, 3½ miles southwest of Canby, Cal.

The channel is straight for 150 feet above and 200 feet below the station. The current is moderate at all stages. The banks are high and are subject to overflow. The channel is rocky and is not subject to much change.

Discharge measurements are made from the bridge. The initial point for soundings is a nail in the railing post at the end of the bridge on the left bank.

The gage is a vertical plank securely fastened to the first bridge pier from the left bank of the stream. During 1905 the gage was read twice each day by Ernest M. Hess. The bench mark is a painted point on a large bowlder at the bend of the wagon road near the south end of the bridge. Elevation, 24.90 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Pit River near Canby, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 5	J. Y. Toler	99	187	2.55	4.20	476
January 9	do	87	127	1.70	3.70	216
January 20	do	99	186	2.53	4.18	470
January 26	do	117	228	2.96	4.50	675
February 7	do	116	220	2.91	4.40	641
February 13	do	87	131	1.91	3.70	250
February 22	do	119	235	3.03	4.60	712
February 27	do	93	147	2.11	3.90	309
March 7	do	87	128	1.86	3.65	238
March 9	do	87	127	1.83	3.65	233
March 14	do	87	135	1.80	3.70	243
March 22	do	109	227	2.90	4.60	659
March 26	do	109	230	2.93	4.65	674
April 4	do	138	292	3.33	5.00	971
April 5	do	138	289	3.30	5.00	955
April 10	do	114	206	2.81	4.40	579
April 16	do	93	146	2.27	4.00	331
April 19	do	93	136	2.07	3.90	282
May 1	do	63	83	1.08	3.30	90
May 2	do	63	83	1.10	3.30	91
May 5	do	61	54	.57	2.90	31
May 16	do	90	120	1.85	3.70	222
May 20	do	90	115	1.84	3.70	212
June 9	do	87	123	1.64	3.60	201
July 17	do	52	40	.60	2.90	24
July 22	do	50	37	.62	2.85	23
August 8	do	60	39	.37	2.80	14.5
August 10	do	60	37	.38	2.75	14.1
August 21	do	9	2.9	1.27	2.50	3.7
August 28	do	7	1.8	1.17	2.45	2.1
August 31	do	7	2.0	1.15	2.45	2.3
September 9	do	8	2.6	1.19	2.50	3.1
September 19	do	9	3.4	1.68	2.60	5.7
October 6	do	35	21	1.00	2.80	21
October 19	do	55	57	.91	3.10	52
October 25	do	58	58	.86	3.20	50
October 28	do	58	61	.90	3.20	55
November 7	do	60	67	1.19	3.30	80
November 11	do	60	70	1.19	3.30	83

Daily gage height, in feet, of Pit River near Canby, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.55	4.6	3.8	5.5	3.4	3.6	3.3	2.9	2.5	2.8	3.2	3.5
2	4.4	5.05	3.8	5.6	3.4	3.7	3.25	2.9	2.5	2.8	3.25	3.5
3	4.1	5.25	3.75	5.5	3.3	3.7	3.25	2.9	2.5	2.8	3.25	3.5
4	4.0	5.65	3.7	5.4	3.0	3.7	3.25	2.9	2.5	2.8	3.3	3.5
5	3.9	4.85	3.7	5.5	3.0	3.7	3.25	2.9	2.5	2.8	3.3	3.5
6	3.8	4.65	3.7	4.8	3.0	3.5	3.25	2.5	2.5	2.8	3.3	3.5
7	3.8	4.25	3.65	4.8	3.6	3.6	3.2	2.5	2.5	2.8	3.3	3.5
8	3.8	4.1	3.65	4.7	3.6	3.7	3.2	2.5	2.5	2.8	3.3	3.5
9	3.7	4.05	3.65	4.5	3.3	3.65	3.2	2.5	2.5	3.05	3.3	3.5
10	3.6	4.0	3.65	4.3	3.15	3.65	3.2	2.5	2.5	3.05	3.3	3.4
11	3.55	3.9	3.65	4.2	3.2	3.6	3.2	2.5	2.5	3.05	3.3	3.4
12	3.45	3.7	3.7	4.1	3.2	3.6	3.2	2.5	2.5	3.05	3.3	3.35
13	3.5	3.7	3.7	4.1	3.2	3.6	3.2	2.5	2.5	3.05	3.3	3.3
14	3.7	3.75	3.7	4.0	3.6	3.5	3.2	2.5	2.5	3.05	3.3	3.3
15	3.95	3.7	3.7	4.0	3.8	3.5	3.2	2.5	2.5	3.1	3.3	3.3
16	4.25	3.65	3.8	4.0	3.8	3.4	3.2	2.5	2.5	3.1	3.25	3.3
17	4.3	3.75	4.1	4.0	3.8	3.4	3.2	2.5	2.5	3.15	3.25	3.3
18	4.3	3.8	4.35	4.0	3.8	3.4	3.2	2.5	2.5	3.15	3.25	3.3
19	4.3	4.2	4.4	4.0	3.8	3.4	3.2	2.5	2.6	3.2	3.25	3.35
20	4.2	4.95	4.5	3.95	3.8	3.4	3.2	2.4	2.6	3.2	3.3	3.4
21	4.1	4.8	4.95	3.85	3.75	3.4	3.2	2.4	2.6	3.2	3.3	3.4
22	4.35	4.6	4.8	3.8	3.7	3.4	3.2	2.4	2.6	3.2	3.3	3.4
23	4.5	4.3	4.45	3.3	3.65	3.4	3.1	2.4	2.6	3.2	3.35	3.4
24	5.0	4.2	4.5	3.3	3.8	3.4	3.1	2.4	2.6	3.2	3.35	3.4
25	5.35	4.1	4.6	3.3	3.7	3.4	3.1	2.4	2.6	3.2	3.4	3.4
26	4.6	4.0	4.7	3.3	3.6	3.4	3.1	2.4	2.6	3.2	3.4	3.4
27	4.2	4.0	4.8	3.4	3.5	3.3	3.1	2.5	2.7	3.2	3.4	3.4
28	4.05	3.9	4.85	3.4	3.5	3.3	3.1	2.5	2.8	3.2	3.4	3.4
29	4.0	.....	4.85	3.5	3.5	3.3	3.1	2.5	2.8	3.2	3.45	3.4
30	4.0	.....	4.8	3.4	3.6	3.3	3.1	2.5	2.8	3.2	3.5	3.4
31	4.15	.....	5.0	.....	3.6	.....	3.1	2.5	.....	3.2	.....	3.4

Station rating table for Pit River near Canby, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	1.5	3.30	87	4.20	475	5.10	1,028
2.50	3.5	3.40	115	4.30	533	5.20	1,091
2.60	6	3.50	148	4.40	593	5.30	1,154
2.70	10	3.60	186	4.50	655	5.40	1,217
2.80	16	3.70	226	4.60	717	5.50	1,280
2.90	24	3.80	269	4.70	779	5.60	1,343
3.00	34	3.90	316	4.80	841		
3.10	47	4.00	366	4.90	903		
3.20	64	4.10	419	5.00	965		

NOTE.—The above table is applicable only for open-channel conditions. It is based on thirty-nine discharge measurements made during 1905. It is well defined between gage heights 2.4 feet and 5 feet.

Estimated monthly discharge of Pit River near Canby, Cal., for 1905.

[Drainage area, 1,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,186	132	443	27,240	0.295	0.340
February	1,374	206	533	29,600	.355	.370
March	965	206	479	29,450	.319	.368
April	1,343	87	510	30,350	.340	.379
May	269	34	165	10,140	.110	.127
June	226	87	151	8,985	.101	.113
July	87	47	61.7	3,794	.041	.047
August	24	1.5	6.4	394	.0043	.0050
September	16	3.5	5.6	333	.0037	.0041
October	64	16	45.4	2,792	.030	.035
November	148	64	92.2	5,486	.061	.068
December	148	87	118	7,256	.079	.091
The year	1,374	1.5	218	155,800	.145	1.95

PIT RIVER NEAR BIEBER, CAL.

This station was established January 22, 1904, by J. S. Evans and William Busch. It is located 12 miles below Bieber, Cal., near Muck Valley.

The channel is straight for 200 feet above and 300 feet below the station. The current is very sluggish at low-water stage. The banks are high and not subject to overflow. The channel is very rocky and rough, but is not subject to change.

Discharge measurements are made from a cable and car. The initial point for soundings is the foot of the platform at end of the cable on the right bank of the stream.

The gage is a heavy wooden rod fastened to a large bowlder on the right bank of the stream. During 1905 the gage was read once each day by F. H. Holabird. The bench mark is on a large bowlder on the right bank 50 feet east of the pine tree to which the cable is fastened; elevation 12.00 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Pit River near Bieber, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 8	J. Y. Toler	104	343	0.99	3.70	340
January 22	do	210	729	1.96	5.25	1,430
January 23	do	218	915	2.46	6.00	2,254
Do	do	217	889	2.50	5.94	2,220
February 9	do	204	630	1.68	4.80	1,060
February 24	do	208	673	1.93	5.08	1,296
March 11	do	144	389	.97	3.70	378
March 24	do	212	743	2.22	5.40	1,650
March 23	do	213	767	2.11	5.51	1,620
April 7	do	210	739	2.02	5.30	1,492
April 6	do	212	757	2.18	5.40	1,648
April 17	do	199	504	1.32	4.30	665
May 3	do	126	232	.61	2.88	141
May 18	do	134	309	.79	3.50	244
June 12	do	126	215	.51	2.80	110
July 7	do	75	143	.24	2.30	34
July 19	do	79	144	.29	2.40	42
August 9	do	58	105	.22	1.85	23
August 18	do	34	18.8	1.02	1.80	19.1
August 29	do	30	12.6	.78	1.70	9.9
September 10	do	6	2.4	.46	1.40	1.1
September 20	do	7	2.0	.60	1.40	1.2
October 7	do	6	2.8	.61	1.50	1.7
October 17	do	31	12.7	.83	1.70	10.5
October 26	do	45	22.5	1.80	2.20	41
November 8	do	80	168	.42	2.60	71

Daily gage height, in feet, of Pit River near Bieber, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.8	5.4	4.6	6.2	3.0	3.2	2.5	2.1	1.5	[a]1.5	[a]2.3	[a]2.4
2	5.0	5.5	4.5	6.3	3.0	3.2	2.45	2.1	1.5	[a]1.5	[a]2.4	[a]2.4
3	4.9	5.3	4.3	6.15	2.9	3.1	2.4	1.9	1.5	[a]1.5	[a]2.4	[a]2.4
4	4.5	5.0	4.0	5.9	2.9	3.1	2.4	1.8	1.4	[a]1.5	[a]2.5	[a]2.4
5	4.2	4.8	4.0	5.7	2.9	3.1	2.4	1.8	1.4	[a]1.5	[a]2.5	[a]2.4
6	3.9	4.6	4.0	5.4	3.0	3.0	2.3	1.8	1.4	[a]1.5	[a]2.5	[a]2.4
7	3.7	6.0	3.9	5.2	3.0	3.0	2.3	1.75	1.4	1.5	[a]2.5	[a]2.4
8	3.7	5.5	3.9	5.1	3.0	2.9	2.3	1.75	1.35	[a]1.5	2.6	[a]2.4
9	3.5	4.8	3.8	5.0	2.9	2.9	2.4	1.85	1.35	[a]1.5	[a]2.6	[a]2.4
10	3.4	4.6	3.7	4.9	2.9	2.8	2.35	1.8	1.4	[a]1.5	[a]2.6	[a]2.4
11	3.4	4.3	3.7	4.7	2.8	2.8	2.45	1.8	1.4	[a]1.5	[a]2.6	[a]2.4
12	3.3	3.9	3.7	4.6	2.8	2.8	2.45	1.5	1.4	[a]1.6	[a]2.6	[a]2.3
13	3.4	3.7	3.7	4.4	2.8	2.8	2.4	1.5	1.4	[a]1.6	[a]2.6	[a]2.3
14	3.4	3.7	3.8	4.3	2.8	2.7	2.4	1.5	[a]1.4	[a]1.6	[a]2.6	[a]2.3
15	3.6	3.9	3.8	4.2	2.8	2.7	2.7	1.5	[a]1.4	[a]1.6	[a]2.7	[a]2.3
16	3.9	4.0	4.0	4.3	3.0	2.7	2.7	1.7	[a]1.4	[a]1.6	[a]2.7	[a]2.3
17	4.95	4.1	4.0	4.3	3.4	2.7	2.7	1.7	[a]1.4	1.7	[a]2.7	[a]2.3
18	5.1	4.3	5.0	4.3	3.5	2.7	2.3	1.8	[a]1.4	2.0	[a]2.7	[a]2.3
19	5.0	4.6	5.4	4.2	3.5	2.5	2.4	1.8	[a]1.4	2.0	[a]2.7	[a]2.3
20	5.0	4.8	5.5	4.0	3.4	2.5	2.4	1.7	[a]1.4	2.0	[a]2.7	[a]2.3
21	5.0	5.0	5.5	4.0	3.4	2.5	2.3	1.7	[a]1.4	2.0	[a]2.7	3.3
22	5.25	5.8	5.8	3.9	3.2	2.4	2.2	1.5	[a]1.4	2.0	[a]2.7	3.3
23	5.95	5.2	5.55	3.9	3.2	2.4	2.2	1.5	[a]1.4	2.0	[a]2.6	2.2
24	6.5	5.05	5.45	3.7	3.2	2.4	2.6	1.5	[a]1.4	[a]2.0	[a]2.6	2.2
25	6.0	5.0	5.4	3.6	3.1	2.3	2.4	1.5	[a]1.4	[a]2.0	[a]2.6	2.2
26	5.8	5.0	5.7	3.4	3.1	2.3	2.1	1.5	[a]1.4	2.2	[a]2.6	2.2
27	5.5	4.8	5.9	3.1	3.0	2.3	2.1	1.7	[a]1.4	[a]2.2	[a]2.6	2.2
28	5.0	4.8	5.8	3.1	3.1	2.7	2.1	1.7	1.5	[a]2.2	[a]2.6	2.2
29	4.8	.....	5.8	3.1	3.2	2.7	2.2	1.7	1.5	[a]2.2	[a]2.6	2.2
30	5.1	.....	5.8	3.0	3.3	2.7	2.2	1.5	[a]1.5	[a]2.3	[a]2.5	2.2
31	5.4	.....	6.0	.....	3.3	.....	2.25	1.5	.....	[a]2.3	.....	2.2

[a] Estimated.

NOTE.—River frozen over December 23–31.

Station rating table for Pit River near Bieber, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	0.5	2.50	64	3.70	349	4.90	1,130
1.40	1.0	2.60	77	3.80	396	5.00	1,215
1.50	2.2	2.70	92	3.90	448	5.20	1,400
1.60	5.8	2.80	109	4.00	505	5.40	1,595
1.70	9.6	2.90	127	4.10	565	5.60	1,810
1.80	13.6	3.00	147	4.20	630	5.80	2,035
1.90	18	3.10	168	4.30	695	6.00	2,270
2.00	23	3.20	190	4.40	760	6.20	2,525
2.10	29	3.30	213	4.50	830	6.40	2,810
2.20	36	3.40	239	4.60	900		
2.30	44	3.50	270	4.70	975		
2.40	53	3.60	307	4.80	1,050		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 26 discharge measurements made during 1905. It is well defined between gage heights 3.5 feet and 6 feet. Below 3.5 feet the table is not so well defined.

Estimated monthly discharge of Pit River near Bieber, Cal., for 1905.

[Drainage area, 2,948 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	2,960	213	1,036	63,700	0.351	0.405
February	2,270	349	1,083	60,150	.367	.382
March	2,270	349	1,101	67,700	.373	.430
April	2,665	147	950	56,530	.322	.359
May	270	109	166	10,210	.056	.065
June	190	44	103	6,129	.035	.039
July	92	29	51.8	3,185	.018	.021
August	29	2.2	9.73	598	.0033	.0038
September	2.2	.8	1.23	73.2	.00042	.00047
October	44	2.2	15.4	947	.0052	.0060
November	92	44	76.1	4,528	.026	.029
December 1-22	213	44	63.9	2,788	.022	.025
The period				276,500		

NOTE.—Discharge interpolated for missing gage heights in September, October, November, and December.

SOUTH FORK OF PIT RIVER NEAR IVY, CAL.

This station was established January 11, 1904, by H. E. Green and J. S. Evans. It is located 3 miles west of Ivy post-office, at the outlet of Jess Valley.

The channel is straight for 200 feet above and 80 feet below the station. The current is sluggish at low-water stage. The right bank is low and subject to overflow in high water. The bed of the stream is composed of earth and is filled with vegetation at low-water stage.

Discharge measurements are made from a cable and car. The initial point for soundings is the foot of the post used for fastening the car on the left bank of the stream.

The gage is a vertical plank fastened to a tree on the left bank 50 feet above the station. It is read only at times discharge measurements are made, as it is impossible to get an observer on account of its isolated location. The bench mark is on a large bowlder 150 feet east of cabin on the right bank and below the station; elevation, 12.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of South Fork of Pit River near Ivy, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
January 1	J. Y. Toler	32	63	0.92	4.90	58
January 13	do	28	37	.62	3.80	23
February 1	do	30	47	1.04	4.18	49
February 17	do	28	42	1.00	4.00	42
March 4	do	28	42	1.05	4.05	44
March 17	do	31	63	1.46	4.72	93
March 30	do	30	51	1.18	4.30	60
April 13	do	33	61	1.41	4.60	86
April 22	do	33	62	1.37	4.60	85
May 12	do	66	104	1.52	5.33	158
May 13	do	66	101	1.53	5.33	155
May 25	do	85	112	1.41	5.40	158
May 26	do	98	118	1.40	5.44	165
June 5	do	107	145	1.34	5.68	195
June 6	do	97	126	1.31	5.50	165
June 17	do	39	80	1.32	5.05	106
June 19	do	38	78	1.28	5.00	100
July 1	do	24	22	1.86	4.15	41
July 13	do	23	19.5	1.79	4.05	35
July 14	do	23	18.3	1.75	4.00	32
July 26	do	15	20	1.60	4.00	32
July 27	do	15	20	1.60	4.00	32
August 15	do	16	19.5	1.44	4.10	28
August 16	do	16	19.8	1.41	4.10	28
August 24	do	16	17.2	1.16	3.70	19.9
September 5	do	6	8.6	1.42	3.20	12.2
September 14	do	14	8.6	1.95	3.30	16.8
October 3	do	15	7.2	1.97	3.20	14.2
October 12	do	15	7.2	1.97	3.20	14.2
October 13	do	15	7.2	2.00	3.20	14.4
October 21	do	16	6.8	2.03	3.20	13.8
November 1	do	15	7.2	2.03	3.20	14.6
November 2	do	16	8.0	2.09	3.20	16.7
November 14	do	16	8.4	2.13	3.20	17.9
November 15	do	16	7.6	2.12	3.20	16.1

WEST VALLEY CREEK NEAR LIKELY, CAL.

This station was established January 7, 1904, by H. E. Green and J. S. Evans. It is located 7 miles east of Likely, Cal., at the outlet of West Valley.

The channel is straight for 200 feet above and 100 feet below the station. The banks are high and not subject to overflow. The bed of the stream is rocky and not subject to change. The current is swift.

Discharge measurements are made from a cable and car, or by wading at low-water stage. The initial point for soundings is a juniper stump on the left bank, which is used for a tieing post for the car. After July 1, 1905, gagings were made at the ranch house near the upper rod. These gagings give a much less discharge than at the regular station. The gage is a vertical plank nailed to a juniper tree on the right bank of the creek. As no one could be obtained to read the station gage, a gage was placed 2 miles above the station near the ranch house, where an observer could be obtained. The gage as read at this point is not considered satisfactory for use in constructing a discharge curve for the gaging station, but only gives a general idea of the fluctuations in the flow of the stream.

Numerous springs and swamps appear in the valley between the gaging station and the ranch house, giving a greater discharge at the gaging station than at this point. During 1905 the gage was read by Jasper L. Fountain. The bench mark is a point marked with paint on a large bowlder 30 feet from the creek on the left bank; elevation, 10.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of West Valley Creek near Likely, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 12	J. Y. Toler	15	22	1.28	3.30	28
January 31	do	15	23	.96	3.20	22
February 2	do	15	22	.93	3.20	20
February 16	do	15	24	1.09	3.22	26
March 4	do	15	24	1.00	3.20	24
March 5	do	15	24	1.00	3.20	24
March 16	do	15	24	1.02	3.22	25
March 17	do	15	32	2.16	3.70	69
March 29	do	15	21	1.43	3.30	30
March 31	do	15	21	1.42	3.30	30
April 13	do	15	22	1.18	3.25	26
April 22	do	15	19	1.19	3.20	23
May 12	do	15	25	1.40	3.32	35
May 13	do	15	26	1.46	3.35	38
May 25	do	15	21	1.05	3.22	22
May 26	do	15	22	.95	3.19	21
June 4	do	15	28	1.68	3.50	47
June 5	do	15	26	1.50	3.40	39
June 6	do	15	25	1.28	3.30	32
June 17	do	15	22	1.18	3.20	26
June 19	do	15	22	1.09	3.15	24
July 1	do	3	4.4	3.84	3.10	16.9
July 13	do	8	10.0	1.74	3.20	17.4
July 14	do	8	10.0	1.74	3.20	17.4
July 26	do	8	9.6	1.72	3.15	16.5
August 15	do	8	10.0	1.70	3.15	17
August 24	do	16	7.2	1.43	3.00	10.3
September 5	do	21	13	1.02	3.10	13.2
September 6	do	21	13.7	1.04	3.10	14.2
September 14	do	17	7.4	1.53	3.10	11.3
September 15	do	17	7.8	1.49	3.10	11.6
October 3	do	18	8.4	1.65	3.10	13.9
October 12	do	19	10.1	1.59	3.20	17.1
October 13	do	19	10.4	1.68	3.20	17.5
October 21	do	18	7.6	1.72	3.10	13.1
October 22	do	18	7.8	1.73	3.10	13.5
November 1	do	13	11.4	1.24	3.20	14.0
November 14	do	13	11.0	1.32	3.20	14.5
November 15	do	13	11.0	1.30	3.20	14.3

NOTE.—After July 1 gagings were made near upper gage.

Daily gage height, in feet, of West Valley Creek near Likely, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.2	3.2	4.5	3.15	3.2	3.2	3.2	3.0	a 3.1	3.15	3.1
2	3.3	3.2	3.2	3.4	3.15	3.2	3.2	3.2	3.0	a 3.1	3.15	[illegible]
3	3.25	3.2	3.2	3.3	3.15	3.2	3.2	3.2	3.0	a 3.1	3.15	3.15
4	3.25	3.2	3.15	3.3	3.15	3.2	3.2	3.2	3.1	a 3.1	3.2	3.15
5	3.25	3.2	3.15	3.3	3.15	3.6	3.2	3.2	3.1	a 3.1	3.2	3.15
6	3.2	3.2	a 3.15	3.3	3.15	3.5	3.2	3.2	3.1	a 3.1	3.2	3.15
7	3.2	3.2	a 3.15	3.25	3.15	3.45	3.2	3.2	3.1	a 3.1	3.2	3.15
8	3.2	3.2	a 3.15	3.25	3.3	3.55	3.2	3.2	3.1	a 3.2	3.2	3.1
9	3.2	3.2	a 3.1	3.25	3.2	3.55	3.15	3.2	3.1	a 3.2	3.2	3.15
10	3.2	3.2	a 3.1	3.25	3.4	3.3	3.15	3.2	3.1	a 3.2	3.2	3.15
11	3.2	3.2	3.1	3.25	3.3	3.3	3.15	3.2	3.1	a 3.2	3.2	3.1
12	3.2	3.2	3.1	3.25	3.25	3.25	3.15	3.2	3.2	a 3.2	3.2	3.15
13	3.2	3.2	3.15	3.25	3.2	3.25	3.15	3.2	3.2	a 3.2	3.2	3.1
14	3.2	3.2	3.2	3.25	3.2	3.2	3.15	3.0	3.2	a 3.2	3.2	3.25
15	3.2	3.2	3.2	3.3	3.2	3.2	3.15	3.0	3.2	a 3.2	3.2	3.15
16	3.2	3.2	3.2	3.3	3.2	3.2	3.15	3.0	3.2	a 3.2	3.2	3.1
17	3.25	3.2	3.65	3.3	3.2	3.2	3.15	3.0	a 3.2	a 3.2	3.2	3.15
18	3.25	3.2	3.4	3.25	3.2	3.2	3.15	3.0	a 3.2	a 3.1	3.2	3.1
19	3.3	3.2	3.5	3.2	3.2	3.2	3.15	3.0	a 3.2	a 3.1	3.2	3.1
20	3.3	3.2	3.35	3.2	3.2	3.2	3.15	3.0	a 3.2	a 3.1	3.6	3.15
21	3.3	3.2	3.5	3.2	3.2	3.2	3.15	3.0	a 3.2	a 3.1	3.4	3.1
22	3.25	3.2	3.5	3.2	3.2	3.2	3.15	3.0	a 3.2	3.1	3.8	3.1
23	3.2	3.2	3.35	3.2	3.2	3.2	3.15	3.0	a 3.2	3.1	3.25	3.15
24	3.2	3.2	3.3	3.2	3.2	3.2	3.15	3.0	a 3.2	3.1	3.1	3.1
25	3.2	3.2	3.3	3.2	3.2	3.2	3.15	3.0	a 3.2	3.1	3.1	3.15
26	3.2	3.2	3.4	3.15	3.2	3.2	3.15	3.0	a 3.2	3.1	3.1	3.1
27	3.2	3.2	3.7	3.15	3.2	3.2	3.15	3.0	a 3.2	3.1	3.15	3.1
28	3.2	3.2	3.4	3.15	3.2	3.2	3.15	3.0	a 3.2	3.1	3.2	3.1
29	3.2	.....	3.35	3.15	3.2	3.2	3.15	3.0	a 3.2	3.1	3.1	3.15
30	3.2	.....	3.4	3.15	3.2	3.2	3.15	3.0	a 3.2	3.1	3.1	3.1
31	3.2	.....	3.5	.....	3.2	.....	3.2	3.0	.....	3.1	.....	3.6

a Estimated.

Daily discharge, in second-feet, of West Valley Creek near Likely, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	28	21	24	188	22	23	20	20	10	16	12
2	28	20	24	38	22	23	20	20	9	15	12
3	25	20	24	30	22	24	20	20	9	14	12
4	25	20	24	30	22	24	19	20	13	14	14
5	25	21	24	30	23	57	19	20	13	14	14
6	22	21	21	30	23	47	19	20	14	15	14
7	22	21	21	26	23	43	18	20	14	15	14
8	22	22	21	26	32	52	18	20	13	16	14
9	22	22	19	26	26	52	16	20	13	16	15
10	22	22	19	26	42	32	16	20	12	16	15
11	22	23	19	26	33	32	15	20	12	17	15
12	22	23	19	26	30	29	15	20	26	17	15
13	22	24	21	26	27	29	15	20	26	18	14
14	22	24	24	26	27	26	15	11	26	18	14
15	22	25	25	30	27	26	15	11	26	17	14
16	22	26	25	30	26	26	15	11	26	16	14
17	25	26	63	30	26	26	15	10	26	16	14
18	25	26	38	26	26	26	15	10	25	15	14
19	28	26	48	23	24	26	16	10	24	14	14
20	28	26	34	23	24	26	16	10	24	14	.....
21	28	26	48	23	24	25	16	10	23	13	.....
22	25	26	48	23	23	25	16	10	22	14	.....
23	22	25	34	23	23	24	16	10	21	14	.....
24	22	25	30	23	21	24	16	10	21	13	.....
25	22	25	30	23	21	23	16	10	20	13	.....
26	22	25	38	21	21	23	17	10	20	12	.....
27	22	25	69	21	21	22	17	10	19	12	.....
28	22	25	38	21	21	22	17	10	18	11	.....
29	22	.....	34	21	22	21	17	10	18	11	.....
30	22	.....	38	21	22	21	17	10	17	10	.....
31	22	.....	48	.....	23	.....	20	10	.....	10	.....

NOTE.—Daily discharge obtained by indirect method for shifting channel, as no measurements were made later than November 19. No estimate has been made for the remainder of the year.

Estimated monthly discharge of West Valley Creek near Likely, Cal., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	28	22	23.5	1,445
February	26	20	23.6	1,311
March	69	19	32.0	1,968
April	188	21	31.2	1,856
May	42	21	24.8	1,525
June	57	21	29.3	1,744
July	20	15	16.8	1,033
August	20	10	14.3	879
September	26	9	18.7	1,113
October	18	10	14.4	885
November 1-19	15	12	13.9	527
The period				14,290

ASH CREEK AT ADIN, CAL.

This station was established March 13, 1904, by J. S. Evans and William Busch. It was originally located one-fourth of a mile above the town of Adin. During the summer the closing of the waste gates in the dam at Adin interfered with the discharge at this point to such an extent that on August 15, 1904, the station was reestablished at a point 100 feet below the wagon bridge in the town of Adin, Cal., which is about 500 feet below the dam.

The channel is straight for 200 feet above and 200 feet below the station. The left bank is high, but the right bank is subject to overflow from the side channel which, in flood diverts water from above the station. The bed of the stream is gravelly and not subject to change.

Discharge measurements are made from a suspension footbridge constructed with one-half inch cables.

The gage is a vertical plank fastened to a tree on the left bank of the stream. During 1905 the gage was read once each day by H. Williams.

A description of this station, with gage heights and discharged data, is contained in Water Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Ash Creek River at Adin, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 7	J. Y. Toler	32	50	0.90	1.96	45
January 21	do	34	69	1.23	2.40	85
January 25	do	35	92	1.35	2.89	124
Do	do	35	95	1.33	3.00	126
February 8	do	34	70	.99	2.30	69
February 11	do	36	78	1.47	2.80	115
February 12	do	36	76	1.30	2.50	99
February 23	do	36	108	1.57	3.30	170
February 26	do	36	93	1.44	2.90	134
March 10	do	35	67	1.07	2.30	72
March 12	do	35	67	1.10	2.30	74
March 13	do	35	68	1.16	2.35	79
March 25	do	36	114	1.27	3.60	145
April 5	do	36	125	1.85	3.95	231
April 8	do	36	107	1.72	3.55	183
Do	do	36	103	1.65	3.40	171
April 16	do	35	82	1.45	2.80	119
April 18	do	35	79	1.34	2.70	106
May 2	do	35	80	1.33	2.70	106
May 3	do	34	60	.98	2.20	59
May 4	do	34	63	1.08	2.10	68
May 17	do	33	56	.86	1.90	48
May 18	do	33	54	.85	1.90	46
May 19	do	33	53	.79	1.85	42
May 20	do	33	53	.76	1.80	40
June 10	do	45	28	1.08	1.80	30
June 11	do	45	27	1.05	1.75	28
June 13	do	44	26	.96	1.70	25
July 6	do	28	22	.93	1.65	20
July 18	do	28	23	.91	1.65	21
July 21	do	26	18.9	1.22	1.70	23
August 8	do	25	15.4	1.28	1.60	19.7
August 10	do	25	15.4	1.29	1.60	19.9
August 17	do	28	19.2	1.10	1.65	20
August 20	do	28	18.4	.98	1.60	18.1
August 29	do	27	16.7	.89	1.50	14.9
August 30	do	27	16.7	.83	1.50	13.8
September 10	do	28	19.2	.98	1.60	18.9
September 11	do	29	21	1.05	1.70	22
September 20[a]	do	7	2.5	.92	1.00	2.3
September 21	do	32	49	.49	1.70	24
October 8	do	30	19.2	1.67	1.70	32
October 9	do	32	50	.59	1.70	29
October 17	do	30	19.2	1.41	1.70	27
October 18	do	34	51	.63	1.80	32
October 26	do	26	50	.63	1.80	31
October 28	do	36	57	.87	2.00	50
November 8	do	34	50	.64	1.80	32
November 9	do	35	53	.84	1.90	44

[a] Water held back by dam above station.

Daily gage height, in feet, of Ash Creek at Adin, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	3.4	2.5	4.1	2.3	1.9	1.7	1.5	1.6	1.7	1.9	1.8
2	2.4	5.9	2.5	6.0	2.2	1.9	1.7	1.6	1.7	1.7	1.9	1.8
3	2.2	3.5	2.5	6.0	2.1	1.9	1.7	1.6	1.7	1.7	1.9	1.8
4	1.9	3.4	2.5	4.6	2.1	1.9	1.6	1.6	1.7	1.7	1.9	1.8
5	1.9	3.4	2.5	4.6	2.1	1.9	1.5	1.6	1.7	1.7	1.9	1.8
6	1.9	3.4	2.5	4.0	2.1	1.8	1.5	1.6	1.8	1.7	1.9	1.8
7	1.9	3.4	2.5	3.7	2.1	1.8	1.5	1.6	1.8	1.7	1.9	1.8
8	1.9	3.2	2.5	3.7	2.1	1.8	1.5	1.6	1.8	1.7	1.9	1.8
9	1.9	2.5	2.4	3.2	2.1	1.8	1.5	1.6	1.8	1.7	1.9	1.8
10	1.9	2.4	2.4	3.2	2.2	1.8	1.5	1.6	1.9	1.8	1.9	1.8
11	1.9	2.3	2.4	3.1	2.2	1.8	1.5	1.6	1.9	1.8	1.9	1.8
12	1.9	2.3	2.4	3.1	2.2	1.8	1.5	1.6	1.8	1.9	1.9	1.8
13	2.0	2.2	2.4	3.0	2.2	1.8	1.5	1.6	1.8	1.9	1.9	1.8
14	2.0	2.1	2.4	3.0	2.2	1.8	1.5	1.6	1.8	1.9	1.9	1.8
15	2.0	2.1	2.4	3.0	2.1	1.8	1.5	1.6	1.8	1.9	1.9	1.8
16	4.0	2.1	2.4	3.0	2.1	1.8	1.5	1.6	1.8	1.9	1.8	1.8
17	2.5	2.2	3.1	2.8	2.1	1.8	1.5	1.6	1.7	1.7	1.8	1.8
18	2.0	3.1	5.1	2.8	2.2	1.8	1.5	1.6	1.7	1.7	1.8	1.8
19	2.8	5.9	6.2	2.8	2.2	1.8	1.5	1.6	1.7	1.7	1.8	1.8
20	2.4	6.0	4.3	2.8	2.3	1.8	1.5	1.6	1.6	1.7	1.8	1.8
21	2.4	3.4	4.6	2.8	2.3	1.7	1.5	1.6	1.6	1.7	1.8	1.8
22	4.1	3.3	4.6	2.8	2.3	1.7	1.5	1.6	1.6	1.7	1.8	1.8
23	4.6	3.3	3.8	2.7	2.1	1.7	1.5	1.6	1.6	1.7	1.8	1.8
24	4.6	2.6	5.4	2.7	2.1	1.7	1.5	1.6	1.6	1.7	1.8	1.8
25	3.0	2.6	3.6	2.7	1.9	1.7	1.5	1.7	1.6	1.7	1.8	1.8
26	2.4	2.3	9.0	2.7	1.9	1.7	1.5	1.7	1.6	1.7	1.8	1.8
27	2.3	2.3	4.6	2.7	1.9	1.7	1.5	1.7	1.6	1.8	1.8	1.8
28	2.3	2.5	4.1	2.8	1.9	1.7	1.5	1.6	1.6	1.8	1.8	1.8
29	2.3	.....	4.2	2.8	1.9	1.7	1.5	1.6	1.6	1.8	1.8	1.8
30	4.5	.....	4.2	2.8	1.9	1.7	1.5	1.6	1.6	1.8	1.8	1.8
31	4.5	.....	4.1	.....	1.9	.....	1.5	1.6	.....	1.9	.....	1.8

Station rating table for Ash Creek at Adin, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	14	2.60	97	3.70	205	4.80	342
1.60	20	2.70	106	3.80	216	4.90	356
1.70	27	2.80	115	3.90	227	5.00	370
1.80	34	2.90	124	4.00	238	5.20	400
1.90	41	3.00	134	4.10	250	5.40	430
2.00	48	3.10	144	4.20	262	5.60	462
2.10	56	3.20	154	4.30	274	5.80	494
2.20	64	3.30	164	4.40	287	6.00	526
2.30	72	3.40	174	4.50	300	6.20	560
2.40	80	3.50	184	4.60	314		
2.50	88	3.60	194	4.70	328		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 49 discharge measurements made during 1905. It is well defined between gage heights 1.5 feet and 4 feet. Above 4 feet the table is a rough approximation.

Estimated monthly discharge of Ash Creek at Adin, Cal., for 1905.

[Drainage area, 260 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	314	41	107	6,579	0.412	0.475
February	526	56	158	8,775	.608	.633
March	1,120	80	214	13,160	.823	.949
April	526	106	176	10,470	.677	.755
May	72	41	56.7	3,486	.218	.251
June	41	27	32.8	1,952	.126	.141
July	27	14	15.5	953	.060	.069
August	27	14	20.5	1,260	.079	.091
September	41	20	27.2	1,618	.105	.117
October	41	27	31.1	1,912	.120	.138
November	41	34	37.5	2,231	.144	.161
December	34	34	34	2,091	.131	.151
The year	1,120	14	75.9	54,490	.292	3.93

McCLOUD RIVER NEAR GREGORY, CAL.

This station was established March 23, 1902, in cooperation with the McCloud River Electric Company. It is located at John's Camp, near Hirze Mountain, 14 miles east of Gregory Post-office, Cal. Baird Station, on the Southern Pacific Railroad, is just across Sacramento River from Gregory.

The channel is straight for 300 feet above and 600 feet below the gaging station. The current is swift at all stages. The banks are high and wooded and not liable to overflow. The bed is composed of limestone on the sides, with some large river gravel and bowlders in the center of the channel.

Measurements are made from a car suspended from a cable. The initial point for soundings is at the gage rod on the right bank of the stream. A line is placed 150 feet below the cable, marking a course for float measurements during floods.

The gage rod is a timber nailed and wired to a tree on the right bank. The bench mark is a point marked with a ring of white paint on the top of a bowlder 10 feet upstream from the 10-foot mark on the cable; elevation, 21.19 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of McCloud River near Gregory, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 21	O. W. Peterson	114	830	6.43	4.58	5,337
February 22	do	114	759	5.47	3.95	4,155
February 22	do	114	766	5.38	3.98	4,120
August 6	Peterson & Lee	103	543	2.55	1.63	1,386

Daily gage height, in feet, of McCloud River near Gregory, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	3.85	2.9	3.4	2.8	2.1	1.8	1.65	1.55	1.55	1.5	1.55
2	2.6	4.5	2.8	3.3	2.7	2.2	1.8	1.65	1.55	1.55	1.5	1.55
3	2.45	3.85	2.8	3.25	2.65	2.1	1.8	1.65	1.55	1.55	1.5	1.55
4	2.3	3.7	2.75	3.2	2.6	2.1	1.8	1.65	1.55	1.55	1.5	1.55
5	2.2	3.6	2.7	3.1	2.5	2.1	1.8	1.6	1.55	1.55	1.5	1.55
6	2.2	3.6	2.7	3.0	2.6	2.05	1.8	1.65	1.55	1.55	1.5	1.55
7	2.15	3.5	2.65	2.9	2.7	2.05	1.8	1.6	1.55	1.6	1.5	1.55
8	2.1	3.3	2.65	2.85	2.8	2.0	1.8	1.6	1.55	1.55	1.5	1.55
9	2.0	3.2	2.6	2.8	2.7	2.0	1.8	1.6	1.55	1.55	1.5	1.55
10	2.0	3.1	2.6	2.7	2.7	2.0	1.8	1.6	1.55	1.55	1.5	1.55
11	2.0	3.0	2.7	2.7	2.7	2.0	1.8	1.6	1.55	1.55	1.5	1.55
12	1.95	2.95	3.05	2.6	2.6	2.0	1.75	1.6	1.55	1.55	1.5	1.55
13	2.05	2.7	4.6	2.6	2.6	1.95	1.75	1.6	1.55	1.55	1.5	1.55
14	3.1	2.6	6.8	2.55	2.55	1.95	1.75	1.6	1.55	1.55	1.5	1.55
15	3.25	2.5	5.25	2.6	2.5	1.9	1.75	1.6	1.55	1.55	1.5	1.55
16	3.3	2.5	4.6	2.8	2.5	1.9	1.7	1.6	1.55	1.55	1.5	1.55
17	3.1	2.4	4.15	2.6	2.5	1.9	1.7	1.6	1.55	1.55	1.5	1.55
18	3.0	2.5	4.0	2.75	2.5	1.9	1.7	1.6	1.55	1.55	1.55	1.55
19	3.0	3.4	4.4	2.9	2.4	1.9	1.7	1.6	1.55	1.55	1.55	1.6
20	2.95	5.3	4.7	2.85	2.4	1.9	1.7	1.6	1.55	1.55	1.55	1.55
21	4.1	4.7	5.2	2.8	2.3	1.85	1.7	1.6	1.55	1.55	1.55	1.55
22	8.05	3.9	4.7	2.8	2.25	1.85	1.7	1.6	1.55	1.55	1.55	1.55
23	7.4	3.6	4.35	2.7	2.3	1.85	1.7	1.6	1.55	1.55	1.55	1.55
24	6.2	3.35	4.0	2.7	2.2	1.85	1.7	1.6	1.55	1.55	1.5	1.55
25	6.6	3.1	3.8	2.7	2.2	1.85	1.7	1.6	1.55	1.55	1.55	1.55
26	5.15	3.1	4.3	2.7	2.2	1.85	1.65	1.6	1.55	1.55	1.55	1.55
27	4.25	3.0	4.0	2.7	2.2	1.8	1.65	1.55	1.55	1.55	1.55	1.55
28	3.8	2.9	3.9	2.6	2.2	1.8	1.65	1.55	1.55	1.55	1.55	1.55
29	3.45	.....	3.9	2.6	2.2	1.8	1.65	1.55	1.55	1.55	1.55	1.55
30	3.25	.....	3.6	2.7	2.2	1.8	1.65	1.55	1.55	1.55	1.55	1.55
31	3.25	.....	3.6	.....	2.1	.....	1.65	1.55	.....	1.5	.....	1.55

Station rating table for McCloud River near Gregory, Cal., from September 23, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	1,090	2.40	2,042	3.80	3,860	5.40	7,170
1.10	1,132	2.50	2,140	3.90	4,030	5.60	7,630
1.20	1,178	2.60	2,242	4.00	4,210	5.80	8,110
1.30	1,228	2.70	2,349	4.10	4,395	6.00	8,600
1.40	1,282	2.80	2,461	4.20	4,585	6.20	9,120
1.50	1,340	2.90	2,578	4.30	4,785	6.40	9,650
1.60	1,402	3.00	2,700	4.40	4,990	6.60	10,190
1.70	1,468	3.10	2,825	4.50	5,200	6.80	10,740
1.80	1,538	3.20	2,955	4.60	5,410	7.00	11,300
1.90	1,612	3.30	3,090	4.70	5,625	7.20	11,870
2.00	1,690	3.40	3,230	4.80	5,840	7.40	12,450
2.10	1,772	3.50	3,380	4.90	6,060	7.60	13,040
2.20	1,858	3.60	3,535	5.00	6,280	7.80	13,640
2.30	1,948	3.70	3,695	5.20	6,720	8.00	14,250

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1902-1905. It is fairly well defined between gage heights 1.5 feet and 4.6 feet. The table has been extended beyond these limits. Above 8 feet the discharge is a rough approximation.

Estimated monthly discharge of McCloud River near Gregory, Cal., for 1902–1905.

[Drainage, 608 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1902						
September 23 to 30	1,340	1,282	1,333	21,150	2.19	0.651
October	2,140	1,228	1,372	84,360	2.26	2.61
November	12,740	1,282	2,799	166,600	4.60	5.13
December	6,060	1,538	2,576	158,400	4.24	4.89
1903						
January	13,340	1,538	2,847	175,100	4.68	5.40
February	2,578	1,772	2,046	113,600	3.37	3.51
March	11,870	2,042	3,723	228,900	6.12	7.06
April	6,060	2,242	2,819	167,700	4.64	5.18
May	2,242	1,612	1,913	117,600	3.15	3.63
June	1,690	1,468	1,545	91,930	2.54	2.83
July	1,468	1,340	1,373	84,420	2.26	2.61
August	1,352	1,311	1,323	81,350	2.18	2.51
September	1,311	1,282	1,305	77,650	2.15	2.40
October	1,435	1,282	1,317	80,980	2.17	2.50
November	14,560	1,282	3,475	206,800	5.72	6.38
December	2,263	1,455	1,829	112,500	3.01	3.47
The year	14,560	1,282	2,126	1,539,000	3.50	47.48
1904						
January	2,042	1,503	1,652	101,600	2.72	3.14
February	39,500	1,468	6,153	353,900	10.12	10.92
March	41,000	3,380	9,310	572,400	15.31	17.65
April	7,285	4,120	5,468	325,400	8.99	10.03
May	4,490	3,090	3,756	230,900	6.18	7.12
June	2,890	1,858	2,218	132,000	3.65	4.07
July	1,858	1,612	1,746	107,400	2.87	3.31
August	1,612	1,503	1,572	96,660	2.59	2.99
September	1,815	1,468	1,512	89,970	2.49	2.78
October	9,785	1,503	2,697	165,800	4.44	5.12
November	2,140	1,503	1,640	97,590	2.70	3.01
December	4,585	1,575	1,844	113,400	3.03	3.49
The year	41,000	1,468	3,297	2,387,000	5.42	73.63
1905						
January	14,400	1,651	3,854	237,000	6.34	7.31
February	6,945	2,042	3,284	182,400	5.40	5.62
March	10,740	2,242	4,062	249,800	6.68	7.70
April	3,230	2,191	2,490	148,200	4.10	4.57
May	2,461	1,772	2,112	129,900	3.47	4.00
June	1,858	1,538	1,648	98,060	2.71	3.02
July	1,538	1,435	1,491	91,680	2.45	2.82
August	1,435	1,371	1,402	86,210	2.31	2.66
September	1,371	1,371	1,371	81,580	2.25	2.51
October	1,402	1,340	1,371	84,300	2.25	2.59
November	1,371	1,340	1,352	80,450	2.22	2.48
December	1,402	1,371	1,372	84,360	2.26	2.61
The year	14,400	1,340	2,151	1,554,000	3.54	47.89

MISCELLANEOUS MEASUREMENTS IN PIT RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Pit River drainage basin during 1905:

Cottonwood Creek, near Lakeview, Oreg.—This stream is tributary to Goose Lake. A measurement was made June 28, 1905, by S. G. Bennett and J. Y. Toler, one-half mile below Wilshire's sawmill and 10 miles above Lakeview, Oreg.

Width, 12.7 feet; area, 4.7 square feet; mean velocity, 1.55 feet per second; discharge, 7.3 second-feet.

Corporation ditch, near Likely, Cal.—This ditch diverts water from the South Fork of Pit River above Likely, Cal. The following measurements were made below head-gate, 2 miles east of Likely, Cal.:

June 7: Width, 5.7 feet; area, 16.3 square feet; mean velocity, 1.42 feet per second; discharge, 23 second-feet.

June 20: Width, 5.6 feet; area, 16.6 square feet; mean velocity, 1.41 feet per second; discharge, 24 second-feet.

September 6: Width, 7.0 feet; area, 19.9 square feet; mean velocity, 1.46 feet per second; discharge, 29 second-feet.

Duke's ditch, near Likely, Cal.—This ditch diverts water from the South Fork of Pit River. The following measurements were made in flume, 400 yards below head-gate, by John Y. Toler:

June 7: Width, 3 feet; area, 2.88 square feet; mean velocity, 4.83 feet per second; discharge, 13.9 second-feet.

June 20: Width, 3 feet; area, 2.3 square feet; mean velocity, 4.25 feet per second; discharge, 9.8 second-feet.

Fitz Hugh Creek, near Alturas, Cal.—This creek is tributary to Pit River. The following measurements were made at Doten's ranch, 10 miles south of Alturas, by John Y. Toler:

July 2: Width, 8.5 feet; area, 2.8 square feet; mean velocity, 0.64 foot per second; discharge, 1.8 second-feet.

July 25: Width, 8.4 feet; area, 2.7 square feet; mean velocity, 0.52 foot per second; discharge, 1.4 second-feet.

September 7: Width, 7.0 feet; area, 2.8 square feet; mean velocity, 0.64 foot per second; discharge, 1.8 second-feet.

September 16: Width, 8 feet; area, 3.6 square feet; mean velocity, 0.78 foot per second; discharge, 2.8 second-feet.

Ganstad's ditch, near Likely, Cal.—This ditch diverts water from the South Fork of the Pit River. The following measurements were made at head-gate, 2 miles east of Likely, Cal., by John Y. Toler:

June 8: Width, 6.6 feet; area, 10.5 square feet; mean velocity, 0.66 foot per second; discharge, 6.9 second-feet.

July 2: Width, 6.6 feet; area, 10.5 square feet; mean velocity, 0.83 foot per second; discharge, 8.7 second-feet.

Gooch's ditch, near Lookout, Cal.—This ditch diverts water from Pit River. A measurement was made 250 yards above bridge at Lookout on June 13 by John Y. Toler.

Width, 14.5 feet; area, 25 square feet; mean velocity, 0.48 foot per second; discharge, 12 second-feet.

E. Lauer and Son's ditch near Alturas, Cal.—This ditch diverts water from Pit River above the town of Alturas, Cal. A measurement was made in flume at XL ranch, 9 miles north of the town of Alturas, Cal., on May 23, by Jno. Y. Toler.

Width, 4.1 feet; area, 0.89 square foot; mean velocity, 1.60 feet per second; discharge, 1.42 second-feet.

Pine Creek near Alturas, Cal.—This stream is a tributary of South Fork of Pit River. The following measurements were made in flume 100 feet below Gibbins & Mulkey's power house, 7 miles east of the town of Alturas, Cal.

August 11: Width, 2.2 feet; area, 2.8 square feet; mean velocity, 4.43 feet per second; discharge, 12.4 second-feet.

August 22: Width, 2.15 feet; area, 2.6 square feet; mean velocity, 4.35 feet per second; discharge, 11.3 second-feet.

October 1: Width, 2.3 feet; area, 3.1 square feet; mean velocity, 3.94 feet per second; discharge, 12.2 second-feet.

Pit River at Lookout, Cal.—The following measurements were made during 1905 at bridge on county road east of town of Lookout, Cal.

June 13: Width, 87 feet; area, 217 square feet; mean velocity, 0.71 foot per second; discharge, 155 second-feet.

July 7: Width, 67 feet; area, 112 square feet; mean velocity, 0.51 foot per second; discharge, 57 second-feet.

July 20: Width, 40 feet; area, 71 square feet; mean velocity, 0.41 foot per second; discharge, 29 second-feet.

August 19: Width, 8 feet; area, 4.8 square feet; mean velocity, 2.06 feet per second; discharge, 9.9 second-feet.

Rush Creek near Adin, Cal.—This stream is a tributary to Ash Creek. The following measurements were made in canyon above upper end of Round Valley north of the town of Alturas, Cal.

July 18: Width, 13 feet; area, 9.7 square feet; mean velocity, 0.56 foot per second; discharge, 5.6 second-feet.

September 22: Width, 9 feet; area, 5.0 square feet; mean velocity, 1.16 feet per second; discharge, 5.8 second-feet.

Von Loam's ditch near Likely, Cal.—This ditch diverts water from the South Fork of Pit River. The following measurements were made below head-gate, 2 miles east of the town of Likely, Cal.

June 8: Width, 7.8 feet; area, 16.9 square feet; mean velocity, 2.09 feet per second; discharge, 35 second-feet.

June 20: Width, 8.5 feet; area, 14.9 square feet; mean velocity, 1.68 feet per second; discharge, 25 second-feet.

Willow Creek near Adin, Cal.—This stream is tributary to Ash Creek. The following measurements were made at bridge on county road, 5 miles south of the town of Adin, Cal.

July 19: Width, 8 feet; area, 5.2 square feet; mean velocity, 1.09 feet per second; discharge, 5.7 second-feet.

September 21: Width, 8 feet; area, 4.4 square feet; mean velocity, 1.00 foot per second; discharge, 4.4 second-feet.

STONY CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Stony Creek drains a portion of the Coast Range and flowing in a northerly direction discharges its waters into the Sacramento River near Orland, Cal. It has numerous tributaries, all of which are torrential in their character. The formation on the higher elevations is of granite with good soil covering and is heavily timbered. In the lower portion of the drainage basin the formation is shale, sandstone, and conglomerate, with heavy growth of brush and grass. This portion of the basin is used extensively for pasturage, the soil being heavy, it packs readily, producing a large per cent of run-off. The mean average rainfall on the higher elevation is about 40 inches; while on the lower reaches it is 20 inches. The precipitation is almost wholly in the form of rain, with some snow on the upper reaches which soon melts and only adds to the flood discharge.

The gaging station on this stream is located near the point where it emerges from the foothills and enters the Sacramento Valley.

STONY CREEK NEAR FRUTO, CAL.

This station was established on January 30, 1901, by Burt Cole. It is located at Julian's ranch, 7 miles northwest of Fruto, and 1¾ miles above the proposed mill-site dam.

The channel is straight for 200 feet above and below the cable. The current is very swift at high water and sluggish at low water. Neither bank is subject to overflow, but at high stages of the creek the water spreads to the right for several hundred feet. The bed of the stream is of gravel and is subject to some change.

Discharge measurements are made from a car and cable. The initial point for soundings is the eyebolt on the left bank to which the cable is attached.

The gage is in two sections. During 1905 the gage was read twice each day by W. H. Julian. The bench mark is the head of an iron bolt set in the rock near the upper gage; elevation, 14.00 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Stony Creek near Fruto, Cal., in 1905.

Date	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 16	O. W. Peterson	130	204	3.35	5.13	684
June 23	do	110	84	1.52	3.90	128
August 4	Peterson and Lee	32	23	1.22	3.30	28
September 8	C. H. Lee	33	32	.51	3.22	16.3
September 14	W. B. Clapp	33	17	.83	3.20	14.1
October 4	Lee and Hawley	24	23	.76	3.24	17.6

Daily gage height, in feet, of Stony Creek near Fruto, Cal., for 1905.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
29	[illegible]	.....	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
30	[illegible]	.....	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.2	3.3	[illegible]
31	[illegible]	.....	[illegible]	.....	[illegible]	.....	[illegible]	[illegible]	.....	3.3	.....	[illegible]

Station rating table for Stony Creek near Fruto, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	10	4.50	350	5.90	1,310	7.60	3,150
3.20	14	4.60	400	6.00	1,400	7.80	3,410
3.30	23	4.70	450	6.10	1,490	8.00	3,680
3.40	34	4.80	500	6.20	1,580	8.20	3,980
3.50	47	4.90	560	6.30	1,680	8.40	4,280
3.60	62	5.00	620	6.40	1,780	8.60	4,600
3.70	80	5.10	685	6.50	1,880	8.80	4,930
3.80	100	5.20	755	6.60	1,980	9.00	5,270
3.90	120	5.30	830	6.70	2,090	9.20	5,630
4.00	150	5.40	905	6.80	2,200	9.40	6,000
4.10	180	5.50	980	6.90	2,310	9.60	6,400
4.20	210	5.60	1,060	7.00	2,420	9.80	6,800
4.30	250	5.70	1,140	7.20	2,660	10.00	7,280
4.40	300	5.80	1,220	7.40	2,900		

NOTE.—The above table is based on 22 discharge measurements made during 1903–1905 and is fairly well defined throughout. Above 3.7 feet the table is the same as for 1904.

Estimated monthly discharge of Stony Creek near Fruto, Cal., for 1905.

[Drainage area, 760 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	6,700	450	2,420	148,800	3.18	3.67
February	7,280	685	1,471	81,700	1.94	2.02
March	5,720	500	2,050	126,000	2.70	3.11
April	1,490	450	870	51,770	1.14	1.27
May	1,680	400	675	41,500	.888	1.02
June	400	80	206	12,260	.271	.302
July	80	14	36.5	2,244	.048	.055
August	14	10	12.4	762	.016	.018
September	14	10	13.7	815	.018	.020
October	23	14	16.3	1,002	.021	.024
November	62	23	27.1	1,613	.036	.040
December	100	62	68.1	4,187	.090	.104
The year	7,280	10	656	472,700	.862	11.62

FEATHER RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Feather River drains a portion of the western slope of the Sierra Nevada extending east nearly to the Nevada State line, a distance of about 75 miles and north and south for a distance of from 30 to 40 miles.

The greater portion of the watershed is rough and mountainous and has numerous tributaries which drain the slopes of the higher mountains. The formation in the southern and eastern part of the basin is of granite, with a comparatively deep soil covering. There is also a considerable area composed of lava and other volcanic matter in the northern part of the basin. Numerous meadows and valleys also exist, which tend to maintain a steady flow during the dry season. The soil is generally porous and absorbs the moisture readily. The entire watershed is well covered with a growth of brush and timber, much of which is large enough to make lumbering a profitable industry, with the exception of the meadow lands and valleys, which are used for stock ranges and grazing lands. There are numerous large springs, especially in the lava districts, which supply a more or less steady flow throughout the year. These are especially noticeable on North Fork, where there are perennial springs discharging from 50 to 100 second-feet. There is little artificial storage in the drainage area, and the water used for irrigation in the valleys is taken from the natural flow of the streams.

The mean annual precipitation is probably from 40 to 60 inches and is well distributed over the area. It falls largely in the form of snow, but disappears in the early part of the summer.

FEATHER RIVER AT OROVILLE, CAL.

This station was established January 1, 1902, by S. G. Bennett. It is located at the northeast edge of the town of Oroville, Cal., where Feather River breaks from the foothills on the western slope of the Sierra Nevada into Sacramento Valley. The drainage area is 3,640 square miles.

The current at the station is sluggish at low water and swift at high water. The channel is rough, rocky, and not subject to much change.

Discharge measurements at low and ordinary stages were made by means of a cable and boat 500 feet above the wagon bridge. High-water measurements were made by means of floats. In February, 1905, a cable with car was placed about 1,000 feet above the bridge. The cable has a span of about 400 feet. The initial point of soundings is the eyebolt on the left bank.

The original gage was previously placed by the United States Weather Bureau and used by them for a number of years. Readings were taken on this rod and reported by the Weather Bureau when there was danger of an overflow on the lower Feather and Sacramento rivers. On August 11, 1904, a new gage rod was put in. The zero of this rod was placed 2 feet lower than that of the old Weather Bureau rod to avoid negative readings at low stages of the river. This rod is placed at the wagon bridge on the left bank of the stream and is in four sections. Three of the lower sections are bolted to rock, and the fourth section, for registering the flood stages, is nailed to the bridge pier. In December, 1905, a staff gage was placed at the station 50 feet below the cable on the left bank. During 1905 the gage was read by D. G. Page, readings being taken from the gage at the bridge. The bench marks are as follows: (1) A point on rock marked with white paint, one-half the distance from the low-water gage to the high-water gage on the bridge pier; elevation, 12.25 feet. (2) A point on rock marked with white paint, 35 feet southwest of low-water gage; elevation, 14.86 feet. (3) A circle of white paint on the point of a rock 15 feet upstream from the 70-foot mark on the cable; elevation, 5.05 feet. (4) A point on rock marked with white paint, 4 feet downstream from 15-foot mark on cable; elevation, 27.16 feet. The elevations of bench marks Nos. 1 and 2 refer to the datum of the gage at the bridge; elevations of bench marks Nos. 3 and 4 refer to the datum of the gage established in December, 1905.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Feather River at Oroville, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 11	O. W. Peterson	281	3,424	2.22	6.45	7,618
February 18	do	279	3,320	2.08	6.10	6,911
May 16	W. B. Clapp	281	3,728	2.28	6.65	8,509
June 26	O. W. Peterson	273	2,419	1.13	2.75	2,744
August 1	Peterson and Lee	270	2,078	.72	1.28	1,495
September 2	C. H. Lee	268	2,005	.62	.86	1,242
October 7	Hawley and Lee	272	2,013	.60	.90	1,210
November 17	R. S. Hawley	270	1,969	.62	.92	1,212

Daily gage height, in feet, of Feather River at Oroville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.0	9.5	6.9	8.3	7.15	5.4	2.1	1.3	0.95	1.0	1.0	1.4
2	8.3	11.3	6.9	8.05	7.05	5.25	2.1	1.25	.9	1.0	1.0	1.35
3	7.4	10.25	6.95	8.15	6.95	5.2	2.1	1.25	.9	.95	1.0	1.2
4	6.65	9.05	7.5	8.1	6.85	5.2	2.05	1.2	.9	.95	1.0	1.15
5	5.8	8.9	7.75	8.05	6.75	5.15	2.0	1.15	.9	.95	.95	1.1
6	5.5	8.95	7.4	8.0	6.55	5.0	2.0	1.15	.95	1.0	.95	1.0
7	5.5	7.85	7.0	8.0	6.45	4.95	1.95	1.15	.95	1.0	.95	1.0
8	5.1	7.4	6.8	8.05	6.35	4.95	1.9	1.1	1.0	1.0	.95	.95
9	4.5	6.95	6.75	8.0	6.25	4.9	1.9	1.1	1.0	1.1	.9	.95
10	4.2	6.7	6.6	7.9	6.15	4.8	1.85	1.05	1.0	1.05	.9	.95
11	3.4	6.5	6.7	7.8	6.1	4.7	1.8	1.05	1.0	1.05	.85	.95
12	3.3	6.25	7.85	7.7	6.0	4.6	1.8	1.05	.95	1.0	.85	1.0
13	3.2	5.9	10.25	7.5	5.85	4.45	1.75	1.05	.95	1.0	.85	1.0
14	10.15	5.6	9.95	7.5	5.9	4.2	1.75	1.0	.9	.95	.85	1.1
15	10.25	5.4	9.45	7.5	6.15	4.1	1.7	1.0	.9	.95	.9	1.2
16	7.65	5.4	8.8	7.4	6.45	3.9	1.7	1.0	.9	.95	.9	1.15
17	5.6	6.35	8.4	7.4	6.6	3.8	1.65	1.05	.85	.95	.9	[a] 1.15
18	5.5	6.35	8.9	7.45	6.5	3.7	1.65	1.05	.85	.95	.9	[a] 1.15
19	7.4	6.1	12.5	7.55	6.45	3.6	1.6	1.05	.85	1.0	.9	[a] 1.15
20	6.65	7.8	11.35	7.35	6.4	3.45	1.6	1.1	.9	1.0	1.0	[a] 1.15
21	7.35	8.25	11.35	6.95	6.4	3.2	1.6	1.1	.9	1.0	1.4	[a] 1.1
22	11.8	7.75	10.95	6.7	6.3	3.15	1.55	1.1	.9	1.0	1.3	[a] 1.1
23	11.95	7.4	10.8	6.8	6.3	3.05	1.5	1.2	.95	1.0	1.3	[a] 1.1
24	10.5	7.3	10.7	6.95	6.3	3.0	1.5	1.2	.95	1.0	1.25	1.1
25	9.8	7.2	9.95	7.15	6.25	2.9	1.5	1.1	.9	.95	1.2	1.15
26	8.65	7.1	9.3	7.3	6.2	2.8	1.45	1.0	.9	.95	1.2	1.15
27	7.9	7.1	9.05	7.45	.....	2.6	1.45	1.0	.9	.95	1.1	1.2
28	7.45	7.0	9.5	7.5	6.0	2.5	1.4	1.0	1.7	.95	1.1	1.2
29	7.1	.....	10.65	7.4	5.95	2.4	1.4	.95	1.3	1.0	1.3	1.3
30	6.85	.....	10.05	7.3	5.85	2.3	1.35	1.0	1.0	1.0	1.4	1.35
31	6.75	.....	8.95	.....	5.65	.....	1.35	1.0	.....	1.0	.....	[a] 1.35

[a] Estimated.

Station rating table for Feather River at Oroville, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	1,230	2.70	2,590	4.40	4,570	7.20	8,640
1.00	1,295	2.80	2,690	4.50	4,700	7.40	9,000
1.10	1,360	2.90	2,790	4.60	4,830	7.60	9,400
1.20	1,430	3.00	2,900	4.70	4,960	7.80	9,800
1.30	1,500	3.10	3,010	4.80	5,090	8.00	10,260
1.40	1,570	3.20	3,120	4.90	5,220	8.20	10,740
1.50	1,640	3.30	3,230	5.00	5,350	8.40	11,260
1.60	1,710	3.40	3,340	5.20	5,630	8.60	11,780
1.70	1,780	3.50	3,450	5.40	5,910	8.80	12,340
1.80	1,850	3.60	3,570	5.60	6,190	9.00	12,900
1.90	1,925	3.70	3,690	5.80	6,470	9.50	14,400
2.00	2,000	3.80	3,810	6.00	6,750	10.00	16,150
2.10	2,075	3.90	3,930	6.20	7,050	10.50	18,100
2.20	2,155	4.00	4,050	6.40	7,350	11.00	20,100
2.30	2,235	4.10	4,180	6.60	7,660	11.50	22,500
2.40	2,315	4.20	4,310	6.80	7,980	12.00	25,100
2.50	2,400	4.30	4,440	7.00	8,300	12.50	28,100
2.60	2,490						

NOTE.--The above table is based on 21 discharge measurements made during 1904-5. It is well defined between gage heights 0.85 foot and 8 feet. Above gage height 3.5 feet the table is the same as for 1904.

Estimated monthly discharge of Feather River at Oroville, Cal., for 1905.

[Drainage area, 3,640 [a] square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	24,800	3,120	9,860	606,300	2.71	3.12
February	21,500	5,910	9,612	533,800	2.64	2.75
March	28,100	7,660	13,560	833,800	3.72	4.29
April	11,000	7,820	9,403	559,500	2.58	2.88
May	8,550	6,260	7,254	446,000	1.99	2.29
June	5,910	2,235	4,098	243,800	1.13	1.26
July	2,075	1,535	1,790	110,100	.492	.567
August	1,500	1,262	1,354	83,250	.372	.429
September	1,780	1,200	1,273	75,750	.350	.390
October	1,360	1,262	1,286	79,070	.353	.407
November	1,570	1,200	1,321	78,610	.363	.405
December	1,570	1,262	1,385	85,160	.380	.438
The year	28,100	1,200	5,183	3,735,000	1.42	19.23

[a] Revised since previous reports.

MISCELLANEOUS MEASUREMENTS IN FEATHER RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Feather River drainage basin during 1905:

Mohawk Creek near New Mohawk, Cal.—A measurement was made on this stream on September 10, 1905, just above its junction with Middle Fork of Feather River by H. A. Campbell.

Width, 12.9 feet; area, 16.9 square feet; mean velocity, 1.18 feet per second; discharge, 20 second-feet.

Middle Fork of Feather River at Mohawk Valley, Cal.—A measurement was made just above mouth of Mohawk Creek on September 10, 1905, by H. A. Campbell.

Width, 10.0 feet; area, 8.8 square feet; mean velocity, 0.17 foot per second; discharge, 1.5 second-feet.

Feather River at Prattville, Cal.—A measurement of this stream was made November 25 at lower end of Big Meadows, 4 miles southeast of Prattville, Cal.

Width, 61 feet; area, 320 square feet; mean velocity, 1.88 feet per second; discharge, 601 second-feet.

Grizzly Creek near Beckwith, Cal.—This stream is tributary to Middle Fork of Feather River. A measurement was made December 17 one-half mile above its junction with Middle Fork and about 2½ miles west of the town of Beckwith, Cal.

Width, 4 feet; area, 1.8 square feet; mean velocity, 1.72 feet per second; discharge, 3.1 second-feet.

Indian Creek near Crescent Mills, Cal.—This stream is tributary to North Fork of Feather River. A measurement was made December 14 at lower end of Indian Valley, one-half mile below highway bridge on Crescent Mill and Taylorsville road, about 1½ miles below the town of Crescent Mills.

Width, 45 feet; area, 66 square feet; mean velocity 1.15 feet per second; discharge, 76 second-feet.

YUBA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yuba River is a tributary of Feather River, which it enters at Marysville, 30 miles above the junction of Feather and Sacramento rivers. The entire drainage area of this river is about 1,327 square miles, of which about 1,220 square miles are above the gaging station at Smartsville. Its extreme length is about 60 miles, and extreme width 56 miles. In the lower stretches of the river, at the location of the present gaging station and in the valley below, the channel has been filled to a considerable depth with débris from hydraulic mining.

The drainage basin is subdivided into 5 small basins, namely: North Fork, with a drainage area of 491.6 square miles; Middle Fork, with a drainage area of 218 square miles; South Fork, with a drainage area of 360 square miles; Deer Creek, with a drainage area of 89.6 square miles, and Dry Creek, with a drainage area of 105.5 square miles. The latter tributary discharges into the main river about 5 miles below the gaging station. The watershed rises gently in rounded and broken mountains, to the crest of the Sierra Nevada, which at the headwaters of the Yuba has a mean elevation of about 8,200 feet, with peaks rising to a height of 9,100 feet. From Mount Lincoln—a peak common to the watersheds of the Yuba, American, and Truckee rivers—to a point about 2½ miles northeast of Mount Weber, the summit of the Sierra Nevada divides the watershed of Yuba River from that of Truckee River, which discharges into Humboldt Basin. Farther north from Mount Weber there is a secondary crest which divides the watersheds of Yuba and Feather rivers, the watershed of the latter stream reaching farther east to a less elevated divide in which the passes are lower than those of the easterly crest.

The western and lower portions of the Yuba drainage basin are composed of slate and kindred rock, very much eroded and merging into the gravel and alluvial deposits of the Sacramento Valley. The upper portions of the basin are composed principally of lavas and granites, all deeply eroded, particularly the lavas. A stratum of serpentine traverses the watershed of the Yuba River in a direction generally parallel with the crest of the Sierras. The North Fork rises in lavas which vary much in composition and hardness, but which generally have a deep soil covering, with timber and brush growth. The Middle Fork rises in similar lavas and granite. The main and tributary streams fall rapidly, and their canyons head well up in the mountains. The sides of these canyons are covered with timber and brush, which, with the deep soil, retain the moisture and feed numerous perennial springs. In the case of the North Fork this is particularly noticeable. The forests of its watersheds make a reliable and constant stream. The mean annual precipitation for the basins of North and Middle forks is about 54 inches. Warm rains on soft snow sometimes give high flood discharge, but snow remains on the higher peaks until midsummer. The headwaters of South Fork lie upon a broad granite surface into which the streams have not cut deeply until the main stream reaches a point 16 miles from the summit, where it drops rapidly into a deeply eroded canyon. This part of the basin has a precipitation annually of about 60 inches. The entire drainage area of the Yuba contains nearly 100 small glacial lakes.

YUBA RIVER NEAR SMARTSVILLE, CAL.

This station was established June 2, 1903, by W. H. Stearns. It is located at what is called "The Narrows," 1 mile from Smartsville, Cal., 18 miles from the Southern Pacific Railroad station at Wheatland, Cal., and 20 miles from Marysville, Cal.

The channel is straight for 200 feet above and 300 feet below the station, and the current is swift at all stages. In the 150 feet above the cable the stream has a fall of 0.2 foot and of 0.9 foot in the 200 feet below. Both banks are high and rocky and are not subject to overflow. The banks widen out considerably just below the station. The bed of the stream is composed of gravel and sand—tailings from hydraulic mining—and is constantly shifting. After the rains of 1904 it was found that the bed of the stream had been lowered for an average depth of 2 feet.

Discharge measurements are made from a car and cable. One auxiliary cable is stretched parallel to and 100 feet upstream from the main cable, and a second one is located 150 feet below the station cable for float measurements. The initial point for soundings is on the left bank at the eyebolt to which the cable is fastened. Frequent discharge measurements are made on account of continual changes of the river bed. These changes, however, do not materially affect discharge measurements for the same gage height.

The gage is in two sections. The lower one is bolted to the rock wall on the left bank of the river and the upper one to the right bank. During 1905 the gage was read once each day by J. R. McKeel. Bench marks were established as follows: (1) A point on a rock marked with white paint, 12 feet upstream and about 15 feet to the left of the right eyebolt; elevation, 39.34 feet. (2) A bolt in shelf of rock marked with white paint, 12 feet from high-water gage on right bank; elevation, 13.75 feet. (3) A bolt in the face of rock 20 feet upstream from the cable on right bank; elevation, 16.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134, United States Geological Survey.

Discharge measurements of Yuba River near Smartsville, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 20	J. R. McKeel	180	688	5.09	6.70	3,500
February 12	do	175	671	4.69	6.30	3,147
February 13	O. W. Peterson	178	665	4.39	6.25	2,920
February 26	J. R. McKeel	180	936	5.76	7.00	5,397
March 5	do	179	836	5.40	6.60	4,512
March 15	do	180	982	6.02	6.90	5,914
April 8	do	170	1,060	6.56	7.00	6,959
April 24	do	170	968	6.64	6.30	6,423
May 4	do	180	868	6.01	5.80	5,221
May 13	do	180	864	5.94	5.50	5,132
May 28	do	183	883	6.31	5.75	5,570
June 4	do	180	732	5.40	5.00	3,955
June 16	do	180	652	5.09	4.50	3,318
July 7	do	155	286	3.58	2.40	1,025
July 20	do	74	165	4.22	2.00	697
July 29	do	73	158	4.01	1.60	634
July 31	O. W. Peterson, C. H. Lee	76	137	3.38	1.64	463
August 7	J. R. McKeel	68	137	3.83	1.50	525
August 15	do	62	126	3.78	1.40	476
August 21	do	68	140	3.80	1.50	532
August 28	do	62	120	3.68	1.30	442
September 5	do	62	120	3.66	1.30	439
September 25	do	57	113	3.56	1.20	402
October 8	Hawley and Lee	74	115	3.43	1.45	395
October 20	J. R. McKeel	66	126	3.62	1.40	456
October 30	do	66	125	3.55	1.35	444
November 9	do	63	121	3.48	1.30	420
November 16	do	63	117	3.44	1.20	403
November 23	do	63	123	3.56	1.35	438
November 30	do	150	224	3.70	2.20	830
December 6	do	70	140	3.80	1.60	533
December 13	do	68	133	3.65	1.50	486
December 29	do	84	167	3.96	1.90	661

Daily gage height, in feet, of Yuba River near Smartsville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.0	7.5	6.7	7.0	6.5	5.5	2.7	1.6	1.3	1.4	1.4	2.0
2	8.4	9.4	6.7	7.0	6.3	5.2	2.7	1.6	1.3	1.4	1.4	1.7
3	7.6	8.5	6.6	7.1	6.1	5.1	2.6	1.6	[a] 1.3	1.4	1.4	1.7
4	7.2	7.9	6.7	7.1	5.8	5.0	[a] 2.5	1.6	1.3	1.4	1.4	1.7
5	6.9	8.5	6.6	7.0	5.7	4.8	2.5	1.6	1.3	1.4	[a] 1.4	1.6
6	6.8	7.6	6.6	7.1	5.7	4.9	2.4	[a] 1.6	1.3	1.3	1.4	1.6
7	6.4	7.2	6.5	7.3	5.6	5.0	2.4	1.5	1.3	1.3	1.4	1.6
8	6.4	7.0	6.5	7.0	6.0	4.9	2.3	1.5	1.3	1.4	1.3	1.6
9	6.3	6.8	6.4	6.9	6.2	4.9	2.3	1.5	1.3	[a] 1.4	1.3	1.5
10	6.2	6.6	6.4	6.9	5.7	4.9	2.2	1.5	[a] 1.3	1.4	1.3	[a] 1.5
11	6.1	6.6	6.3	6.5	5.7	5.2	2.2	1.5	1.3	1.4	1.3	1.5
12	6.1	6.3	6.4	6.3	5.5	5.0	2.2	1.5	1.2	1.4	[a] 1.3	1.5
13	6.1	6.2	7.3	6.3	5.5	5.0	2.1	[a] 1.5	1.2	1.4	1.3	1.5
14	8.2	6.1	7.7	6.2	[a] 5.8	4.7	2.1	1.5	1.2	1.4	1.3	1.5
15	7.7	6.1	6.9	6.2	6.1	4.7	2.1	1.4	1.2	[a] 1.3	1.3	1.5
16	7.3	6.0	6.8	6.4	6.9	4.5	2.1	1.4	1.2	1.3	1.2	1.6
17	6.9	7.0	6.6	6.0	7.0	4.5	2.0	1.4	[a] 1.2	1.3	1.2	1.6
18	6.3	7.0	7.3	7.2	6.9	4.3	2.0	1.4	1.2	1.4	1.2	2.0
19	[a] 6.5	6.9	11.3	6.3	6.9	4.2	2.0	1.4	[a] 1.2	1.4	[a] 1.4	2.0
20	6.7	8.5	8.8	6.0	6.8	4.0	2.0	[a] 1.4	1.2	1.4	1.5	2.4
21	7.5	7.4	9.4	6.0	7.0	3.8	1.9	1.4	1.2	1.4	1.6	2.0
22	10.4	7.1	8.5	6.0	6.3	3.6	1.9	1.5	1.2	[a] 1.4	1.4	1.8
23	10.0	6.9	7.9	6.1	6.2	3.4	1.8	1.4	1.2	1.4	1.4	1.6
24	8.9	6.8	8.4	6.3	6.0	3.3	1.8	1.4	[a] 1.2	1.4	1.3	1.6
25	8.2	6.9	8.0	6.6	6.2	3.2	1.8	1.4	1.2	1.4	1.4	1.6
26	7.8	7.0	8.1	7.0	6.5	3.1	1.7	1.4	1.2	1.5	[a] 1.6	1.6
27	7.4	6.9	8.0	7.4	5.8	3.0	1.7	[a] 1.4	1.5	1.4	1.8	1.6
28	7.1	6.8	7.5	7.1	5.7	2.9	1.7	1.3	1.5	[a] 1.4	1.6	1.8
29	6.9	.....	8.4	7.0	5.6	2.8	1.6	1.3	1.4	[a] 1.4	1.8	1.8
30	6.8	.....	8.0	7.1	5.5	2.8	1.6	1.3	1.4	1.4	2.2	1.8
31	6.7	.....	7.3	.....	5.5	.....	1.6	1.3	.....	1.4	.....	1.8

[a] Gage heights estimated.

Daily discharge, in second-feet, of Yuba River near Smartsville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8,500	5,200	4,750	6,730	6,845	4,920	1,235	515	435	455	455	710
2	7,000	10,050	4,750	6,730	6,440	4,395	1,235	515	435	455	455	555
3	5,120	7,650	4,550	7,060	6,045	4,225	1,145	515	435	455	455	555
4	4,300	6,150	4,750	7,060	5,470	4,060	1,060	515	435	455	455	555
5	3,750	7,680	4,512	6,850	5,285	3,745	1,060	515	435	455	455	515
6	3,570	5,500	4,512	7,160	5,285	3,900	980	515	435	435	455	515
7	2,920	4,670	4,460	7,600	5,100	4,060	980	480	435	435	455	515
8	2,920	4,310	4,460	6,960	5,850	3,900	905	480	435	455	435	515
9	2,770	3,950	4,400	6,750	6,240	3,900	905	480	435	455	435	480
10	2,630	3,600	4,650	6,900	5,285	3,900	835	480	435	455	435	480
11	2,510	3,650	4,400	6,160	5,285	4,395	835	480	435	455	435	480
12	2,510	3,147	4,700	5,770	4,920	4,060	835	480	415	455	435	480
13	2,510	2,920	6,700	5,900	4,920	4,060	770	480	415	455	435	480
14	6,500	2,780	7,850	5,700	5,470	3,595	770	480	415	455	435	480
15	5,350	2,780	5,914	5,800	6,045	3,595	770	455	415	435	435	480
16	4,500	2,750	5,710	6,190	7,700	3,300	770	455	415	435	415	515
17	3,850	4,550	5,420	5,520	7,920	3,300	710	455	415	435	415	515
18	2,850	4,650	6,800	8,000	7,700	3,015	710	455	415	455	415	710
19	3,160	4,500	17,400	6,200	7,700	2,880	710	455	415	455	435	710
20	3,500	8,400	10,320	5,620	7,480	2,620	710	455	415	455	480	980
21	5,040	5,800	11,800	5,720	7,920	2,375	650	455	415	455	515	710
22	12,850	5,250	9,700	5,720	6,440	2,145	650	480	415	455	455	600
23	11,550	4,920	8,350	6,030	6,240	1,930	600	455	415	455	455	515
24	8,520	4,800	9,500	6,420	5,850	1,825	600	455	415	455	435	515
25	6,750	5,060	8,700	7,055	6,240	1,720	600	455	415	455	455	515
26	5,800	5,397	8,900	7,920	6,845	1,620	555	455	415	480	515	515
27	4,950	5,150	8,700	8,800	5,470	1,520	555	455	480	455	600	515
28	4,350	4,950	7,800	8,140	5,285	1,420	555	435	480	455	515	600
29	4,000	.....	9,720	7,920	5,100	1,325	515	435	455	455	600	650
30	3,820	.....	8,800	8,140	4,920	1,325	515	435	455	455	835	600
31	3,650	.....	7,350	.....	4,920	.....	515	435	.....	455	.....	600

NOTE.—January 1 to April 24 the daily discharge was obtained indirectly. From April 25 to December 31 the daily discharge was obtained from a rating table based on measurements subsequent to April 24.

Estimated monthly discharge of Yuba River near Smartsville, Cal., for 1905.

[Drainage area, 1,220 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	12,850	2,510	4,903	301,500	4.02	4.64
February	10,050	2,750	5,008	278,100	4.10	4.27
March	17,400	4,400	7,107	437,000	5.83	6.72
April	8,800	5,520	6,751	401,700	5.53	6.17
May	7,920	4,920	6,071	373,300	4.98	5.74
June	4,920	1,325	3,101	184,500	2.54	2.83
July	1,235	515	782	48,080	.641	.739
August	515	435	471	28,960	.386	.445
September	480	415	429	25,530	.352	.393
October	480	435	453	27,850	.371	.428
November	835	415	474	28,200	.389	.434
December	980	480	566	34,800	.464	.535
The year	12,850	415	3,010	2,170,000	2.47	33.34

MISCELLANEOUS MEASUREMENTS, YUBA RIVER DRAINAGE BASIN.

Bay Counties Power Company flume near Nevada City, Cal.—A measurement was made in the flume opposite Purdon bridge over the South Fork of Yuba River on September 3, 1905, by H. A. Campbell.

Width, 6 feet; area, 13.5 square feet; mean velocity, 5.11 feet per second; discharge, 69 second-feet.

Middle Fork of Yuba River near Nevada City, Cal.—A measurement was made one-half mile upstream from Freeman's bridge and about 3 miles north of Nevada City on September 4, 1905, by H. A. Campbell.

Width, 22 feet; area, 31 square feet; mean velocity, 2.06 feet per second; discharge, 64 second-feet.

North Fork of Yuba River near Goodyears bar, Cal.—A measurement was made on this stream September 5, 1905, from the downstream side of the wagon bridge at Goodyears bar by H. A. Campbell.

Width, 44 feet; area, 96 square feet; mean velocity, 1.54 feet per second; discharge, 149 second-feet.

North Fork of North Fork of Yuba River near Downieville, Cal.—This stream enters the North Fork of Yuba River at Downieville, Cal. A measurement was made 1½ miles north of Downieville and 100 yards above its junction with Middle Fork of North Fork on September 6, 1905, by H. A. Campbell.

Width, 10 feet; area, 18.5 square feet; mean velocity, 0.36 foot per second; discharge, 6.7 second-feet.

A measurement was made 30 yards below junction of Middle Fork of North Fork of Yuba River, about 1½ miles north of Downieville, Cal., on September 6, 1905, by H. A. Campbell.

Width, 26 feet; area, 37 square feet; mean velocity, 0.73 foot per second; discharge, 27 second-feet.

Wheeler flume near Downieville, Cal.—This flume takes water from the East Fork of the North Fork of Yuba River. A measurement was made on September 6, 1905, at the headgate three-fourths mile north of Downieville by H. A. Campbell.

Width, 3.1 feet; area, 2.3 square feet; mean velocity, 1.91 feet per second; discharge, 4.4 second-feet.

Davis ditch near Downieville, Cal.—This ditch is taken out of East Fork of North Fork of Yuba River about a mile above Downieville. A measurement was made one-half mile below the head-gate on September 6, 1905, by H. A. Campbell.

Width, 3.0 feet; area, 1.9 square feet; mean velocity, 1.47 feet per second; discharge, 2.8 second-feet.

East Fork of North Fork of Yuba River at Downieville, Cal.—A measurement was made on September 6, 1905, 10 yards above its junction with North Fork of North Fork of Yuba River at Downieville by H A. Campbell.

Width, 22 feet; area, 29 square feet; mean velocity, 0.59 foot per second; discharge, 17 second-feet.

North Fork of North Fork of Yuba River at Downieville, Cal.—A measurement was made on September 6, 1905, on this stream 10 yards above its junction with North Fork of Yuba River by H. A. Campbell.

Width, 28 feet; area, 52 square feet; mean velocity, 0.77 foot per second; discharge, 40 second-feet.

North Fork of Yuba River at Downieville, Cal.—A measurement was made from the upstream side of the wagon bridge at Downieville on September 6, 1905, by H. A. Campbell.

Width, 40 feet; area, 184 square feet; mean velocity, 0.76 foot per second; discharge, 139 second-feet.

South Fork of North Fork of Yuba River near Sierra City, Cal.—A measurement was made on September 7, 1905, by H. A. Campbell, about one-third of a mile above its junction with the North Fork of the North Fork and about 1¼ miles east of Sierra City.

Width, 2.7 feet; area, 2.5 square feet; mean velocity, 0.68 foot per second; discharge, 1.7 second-feet.

Mining company's flume near Sierra City, Cal.—A measurement was made on September 7, 1905, by H. A. Campbell, about 1 mile below heading.

Width, 2.5 feet; area, 2.2 square feet; mean velocity, 4.50 feet per second; discharge, 9.9 second-feet.

North Fork of North Fork of Yuba River near Sierra City, Cal.—A measurement was made on September 7, 1905, by H. A. Campbell, about one-half mile above its junction with the South Fork of the North Fork and about 1 mile east of Sierra City.

Width, 25 feet; area, 41 square feet; mean velocity, 0.56 foot per second; discharge, 23 second-feet.

BEAR RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Bear River drains an area of 287 square miles between the Yuba and American rivers. Its headwaters do not reach back to the crest of the range so that it seldom receives precipitation in the form of lasting snow. It is torrential in character, having no forested areas except in its upper portion. The rainfall records kept by the Central Pacific from Auburn to Emigrant Gap are indicative of the precipitiation in the southern part of its basin. A 28-year record at Grass Valley in the northern portion of its watershed gives a mean of 49.41 inches.

BEAR RIVER ABOVE WHEATLAND, CAL.

This station was established by O. W. Peterson on October 8, 1904. It is located about 800 feet below McCourtney Crossing and 8 miles above Wheatland.

The channel is straight for 350 feet both above and below the station. At ordinary stages the velocity is moderate. Neither bank is subject to overflow. The bed of the stream is composed of gravel and is not subject to any material change.

Discharge measurements are made from a car and cable. An auxiliary cable is located 150 feet downstream and parallel to the large one, so that float measurements can be made at very high water. The white-oak tree to which the right end of the cable is fastened is the initial point for soundings.

The gage rods are 300 feet above the station, on the left bank of the river. Two of the sections are bolted to the rock and the upper section is nailed to a tree. During 1905 the

gage was read once each day by Hermann Ernestus. A standard United States Geological Survey bench mark is sulphured in a hole drilled in the rock between the two upper sections of the gage; elevation, 12.26 feet above the datum of the gage.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Bear River above Wheatland, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 8	F. R. S. Buttemer	142	225	4.21	5.10	94[illegible]
February 13	do	140	165	3.62	4.57	59[illegible]
February 19	do	139	172	3.66	4.66	63[illegible]
February 24	do	139	151	3.50	4.50	53[illegible]
June 27	O. W. Peterson	42	47	1.89	3.42	9[illegible]
July 30	Peterson and Lee	27	39	.95	3.10	3[illegible]
September 3	C. H. Lee	31	44	1.43	3.24	63
October 10	Hawley and Lee	26	20	2.15	3.00	43

Daily gage height, in feet, of Bear River above Wheatland, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.0	5.6	4.3	a 5.45	a 4.1	a 4.1	3.2	3.1	3.2	3.1	3.1	3.4
2	4.8	7.0	4.2	5.3	a 4.2	a 4.1	3.2	3.1	3.2	3.1	3.0	3.3
3	4.3	4.9	4.2	5.0	4.5	a 4.1	3.2	3.1	3.2	3.1	3.0	3.2
4	4.2	6.7	4.2	4.9	4.2	a 4.1	3.2	3.1	3.2	3.1	3.0	3.2
5	4.2	7.0	4.2	4.8	a 4.4	a 4.1	3.2	3.1	3.4	3.1	3.0	3.2
6	4.1	5.5	4.2	4.7	a 4.5	a 4.0	3.2	3.1	3.2	3.1	3.0	3.1
7	4.0	5.1	4.2	4.6	4.6	a 4.0	3.1	3.1	3.2	3.1	3.0	3.1
8	3.9	5.2	4.1	4.5	a 4.7	a 3.8	3.1	3.1	3.2	3.1	3.0	3.1
9	4.4	5.0	4.0	4.4	4.8	a 3.8	3.1	3.1	3.2	3.1	3.0	3.1
10	4.2	4.8	4.0	4.4	a 4.7	a 3.8	3.1	3.1	3.1	3.1	3.0	3.0
11	4.0	4.9	4.0	4.4	a 4.7	a 3.8	3.1	3.1	3.1	3.1	3.0	3.0
12	3.9	4.6	4.2	4.4	a 4.7	a 3.8	3.1	3.1	3.1	3.1	3.0	3.0
13	3.8	4.5	4.7	4.3	a 4.7	a 3.8	3.1	3.35	3.1	3.1	2.9	3.0
14	5.0	4.4	4.6	4.3	a 4.7	a 3.8	3.1	3.1	3.1	3.1	2.9	3.0
15	4.5	4.3	4.4	4.3	a 5.1	a 3.8	3.2	3.4	3.1	3.1	2.9	3.0
16	4.8	4.7	4.4	4.5	a 5.5	a 3.6	3.1	3.1	3.1	3.1	2.9	3.1
17	4.4	5.0	4.4	4.4	a 5.5	a 3.6	3.1	3.1	3.1	3.1	2.9	3.0
18	4.3	4.8	4.9	4.9	a 5.2	a 3.6	3.2	3.1	3.0	3.1	2.9	3.0
19	4.9	4.7	10.5	4.9	a 5.0	a 3.6	3.1	3.1	3.0	3.1	2.9	3.2
20	4.6	5.1	6.8	4.6	a 5.0	a 3.6	3.1	3.1	3.0	3.1	3.0	3.4
21	6.5	4.9	6.8	4.7	a 4.8	a 3.6	3.1	3.1	3.0	3.1	3.1	3.3
22	8.5	4.7	5.9	4.7	a 4.6	a 3.6	3.1	3.1	3.0	3.1	3.0	3.2
23	7.5	4.6	5.4	4.5	a 4.5	a 3.5	3.1	3.1	3.0	3.0	3.0	3.1
24	5.7	4.5	5.9	4.4	a 4.4	a 3.5	3.1	3.1	3.0	3.1	3.0	3.0
25	5.2	4.5	5.3	4.3	a 4.3	a 3.5	3.1	3.1	3.2	3.1	3.0	3.0
26	5.0	4.4	5.5	4.2	a 4.3	a 3.5	3.1	3.1	3.1	3.1	3.0	3.0
27	5.8	4.4	5.7	a 4.2	a 4.2	3.5	3.1	3.1	3.1	3.0	3.35	3.0
28	5.6	4.3	5.4	a 4.2	a 4.2	3.5	3.1	3.1	3.1	3.1	3.2	3.0
29	5.5	.....	7.0	a 4.1	a 4.2	3.4	3.1	3.1	3.2	3.1	3.2	3.4
30	5.5	.....	6.2	4.1	a 4.2	3.3	3.1	3.3	3.1	3.1	3.5	3.2
31	5.8	.....	5.6	.....	a 4.2	.....	3.1	3.2	.....	3.1	.....	3.3

4.4 sec.

a Estimated.

Station rating table for Bear River above Wheatland, Cal., from October 9, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.90	10	4.10	328	5.30	1,105	7.00	3,250
3.00	20	4.20	375	5.40	1,200	7.20	3,575
3.10	33	4.30	425	5.50	1,300	7.40	3,910
3.20	49	4.40	475	5.60	1,405	7.60	4,265
3.30	69	4.50	530	5.70	1,515	7.80	4,635
3.40	92	4.60	585	5.80	1,625	8.00	5,020
3.50	118	4.70	645	5.90	1,740	8.20	5,410
3.60	146	4.80	710	6.00	1,860	8.40	5,810
3.70	177	4.90	780	6.20	2,105	8.60	6,220
3.80	210	5.00	855	6.40	2,365	8.80	6,640
3.90	246	5.10	930	6.60	2,640	9.00	7,060
4.00	285	5.20	1,015	6.80	2,935		

NOTE.—The above table is based on 11 discharge measurements made during 1904-5. It is well defined between gage heights 3.1 feet and 5.1 feet. Above 6 feet the table is a rough approximation.

Estimated monthly discharge of Bear River above Wheatland, Cal., for 1904 and 1905.

[Drainage area, 263 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
1904.						
October 9-31	7,060	92	559	25,500	2.13	1.82
November	1,300	92	223	13,270	.848	.946
December	6,640	118	504	30,990	1.92	2.21
1905.						
January	6,015	210	1,058	65,060	4.02	4.64
February	3,250	425	975	54,150	3.71	3.86
March	10,210	285	1,300	79,930	4.94	5.70
April	1,250	328	576	34,270	2.19	2.44
May	1,300	328	615	37,820	2.34	2.70
June	328	69	193	11,480	.734	.819
July	49	33	37.1	2,281	.141	.163
August	92	33	38.1	2,343	.145	.167
September	92	20	37.3	2,220	.142	.158
October	33	20	32.2	1,980	.122	.141
November	118	10	23.8	1,416	.090	.100
December	92	20	39.8	2,447	.151	.174
The year	10,210	10	410	295,400	1.56	21.06

NOTE.—Discharge estimated for missing gage heights.

MISCELLANEOUS MEASUREMENTS IN BEAR RIVER DRAINAGE BASIN.

South Yuba Mining Company's ditch near Colfax, Cal.—This ditch is taken out of Bear River 2½ miles east of Colfax. A measurement was made September 1, 1905, one-eighth of a mile below this heading in flume, by H. A. Campbell.

Width, 6.0 feet; area, 11.8 square feet; mean velocity, 2 54 feet per second; discharge, 30 second-feet.

Bear River near Colfax, Cal.—A measurement was made September 1, 1905, one-eighth of a mile below intake of the South Yuba Mining Company's canal and 2½ miles northeast of Colfax, by H. A. Campbell.

Width, 29 feet; area, 17.8 square feet; mean velocity, 1.45 feet per second; discharge, 26 second-feet.

Green Horn River near Colfax, Cal.—A measurement was made 75 yards above the junction of Big Horn and Bear rivers and about 3½ miles north of Colfax on September 1. 1905. by H. A. Campbell.

Width, 10 feet; area, 6.0 square feet; mean velocity, 1.13 feet per second; discharge, 6.8 second-feet.

Bear River near Colfax, Cal.—A measurement was made on this stream on September 1. 1905, about 100 yards above mouth of Green Horn River and 3½ miles north of Colfax.

Width, 24 feet; area, 21 square feet; mean velocity, 2.05 feet per second; discharge, 43 second-feet.

CACHE CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Cache Creek drains that portion of the eastern slope of the Coast Range directly north from the Puta Creek basin. This basin is long and narrow, extending from northwest to southeast; it has numerous tributaries, of which North Fork is the largest. Most of these tributaries are torrential in their character, but the flow of the main stream is regulated largely by its discharge from Clear Lake, which is fed by numerous creeks having their source in the higher portion of the drainage basin. The lake covers an area of 65 square miles, and has a drainage area of 417 square miles. The streams which enter Cache Creek below Clear Lake are practically dry during the summer months. There are large cultivated areas on the west side of Clear Lake, a greater portion of which is meadow land used for stock raising. There are two gaging stations located on this stream—one at Lower Lake directly at the point where the stream discharges from the lake and one at Yolo a short distance below where it emerges from the foothills. There are numerous diversions above the gaging station at Yolo which take practically the entire flow during the summer months. This water is used for irrigation in the vicinity of Woodland and Yolo, where the soil is rich and deep and susceptible of the highest state of cultivation.

CLEAR LAKE AT LAKEPORT, CAL.

This station was established in January, 1901. It embraces evaporation for both lake and land. The lake pan is held in place by a triangular raft placed in a protected arm of the lake and anchored in such a manner that it has a clear swing, adjusting itself to the wind so one of its angles will cut the water. The pan is submerged to within an inch or so of the water surface. The land pan is located in a clear open space and set in the ground so that its top is flush with the ground surface, it being protected by a small wire fence that it may not be disturbed. These pans are the regulation type, as referred to in Circular No. 4 of instructions for observing evaporation. The record of this station from January, 1901, to December, 1904, was published in Water-Supply Paper No. 134. The observer is Mr. D. C. Rumsey, at Lakeport, Cal.

Evaporation record of Clear Lake at Lakeport, Cal., 1905.

Month.	Evaporation in inches.		Month.	Evaporation in inches.	
	Lake.	Land.		Lake.	Land.
January	0.60	0.60	August	7.25	8.45
February	.90	1.10	September	5.95	6.65
March	1.05	1.15	October	3.10	3.55
April	2.45	2.85	November	1.30	1.55
May	3.45	3.70	December	.95	1.05
June	6.50	7.00			
July	7.70	8.90	Annual	41.20	46.55

CACHE CREEK AT LOWER LAKE, CAL.

This station was established January 1, 1900, by S. G. Bennett. It is located three-fourths mile from Lower Lake, Cal.

The channel is straight for 150 feet above and 300 feet below the station. The current has a moderate velocity at ordinary stages. The right bank is low, and will overflow at a gage height of about 10 feet. It is covered with a thick growth of willow and oak trees for 100 feet back from the water's edge. The left bank is high and rocky, and is not liable to overflow. The bed of the stream is composed of firm gravel, and changes only slightly. Gravel is sometimes washed in from Siegler Creek 300 feet below the cable.

Discharge measurements are made from a cable 300 feet above the wagon bridge. The initial point for soundings is a small tree in line with the cable on the left bank, 28 feet from the tree to which the cable is attached.

The present gage is a vertical plank nailed to a timber driven into the bed of the river and fastened to a large willow tree on the left bank 100 feet above the cable. On March 25, 1903, when the new gage was put in place, the reading was 5.7 feet. The old gage read 4.4 feet on the same date. During 1905 the gage was read once each day by Mr. J. R. Anderson. The bench mark is a nail in the root of the oak tree, to which cable is fastened on the left bank; elevation, 8.43 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Cache Creek at Lower Lake, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 1	J. R. Anderson	51	138	1.86	4.10	257
January 7	do	51	146	2.05	4.20	300
January 14[a]	do	52	159	2.08	4.50	331
January 15	do	52	159	2.35	4.50	373
January 22	do	52	178	2.61	4.90	467
January 23[a]	do	56	222	1.35	5.60	299
January 24	do	52	202	2.86	5.40	580
January 26	do	53	218	3.09	5.60	673
January 31	do	53	229	3.27	5.80	748
February 1[a]	do	60	273	2.06	6.48	562
February 2[a]	do	56	254	3.11	6.20	790
February 9	do	56	266	3.63	6.40	965
February 15	do	56	254	3.34	6.20	848
February 21	do	56	258	3.44	6.30	888
February 27	do	56	256	3.38	6.20	864
March 5	do	56	249	3.33	6.10	828
March 11	do	56	234	3.24	5.80	757
March 13[a]	do	60	286	2.18	6.68	625
March 14	do	56	248	3.28	6.08	814
March 20	do	59	271	3.52	6.52	955
March 25	do	60	296	3.69	6.90	1,092
March 31	do	60	308	3.76	7.10	1,159
April 7	do	60	305	3.63	7.00	1,108
April 15	do	56	277	3.55	6.60	984
April 22	do	56	259	3.42	6.35	886
April 29	do	56	248	3.34	6.10	829
May 6	do	56	233	3.24	5.80	755
July 11	O. W. Peterson	54	153	2.53	4.30	387
September 29	C. H. Lee	53	86	.93	2.83	80
October 8	J. R. Anderson	48	73	.86	2.70	63
October 14	do	48	73	.82	2.70	60
October 21	do	48	68	.70	2.60	48
November 5	do	48	62	.50	2.50	31
November 11	do	48	61	.46	2.45	28
November 22	do	48	58	.41	2.40	24
November 27	do	48	54	.37	2.30	20

[a] Backwater from Siegler Creek.

Daily gage height, in feet, of Cache Creek at Lower Lake, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	6.5	6.2	7.3	5.9	5.3	4.5	3.8	3.25	2.8	2.5	2.5
2	4.1	6.2	6.15	7.1	6.0	5.3	4.5	3.8	3.2	2.8	2.5	2.5
3	4.15	6.25	6.15	7.05	6.0	5.25	4.45	3.75	3.2	2.8	2.5	2.45
4	4.2	6.25	6.1	7.0	5.95	5.25	4.4	3.75	3.2	2.8	2.5	2.45
5	4.2	6.35	6.1	7.0	5.90	5.2	4.4	3.7	3.2	2.8	2.5	2.45
6	4.2	6.4	6.1	7.0	5.8	5.2	4.4	3.7	3.15	2.8	2.5	2.4
7	4.2	6.4	6.05	7.0	6.05	5.15	4.4	3.7	3.15	2.75	2.45	2.4
8	4.2	6.4	6.0	7.0	6.0	5.15	4.4	3.7	3.15	2.75	2.45	2.4
9	4.2	6.4	6.0	6.9	5.9	5.1	4.35	3.7	3.1	2.75	2.45	2.4
10	4.2	6.4	5.9	6.8	5.85	5.1	4.35	3.7	3.1	2.7	2.45	2.35
11	4.2	6.3	5.8	6.8	5.8	5.05	4.3	3.65	3.1	2.7	2.45	2.35
12	4.2	6.3	6.2	6.85	5.8	5.0	4.3	3.65	3.05	2.7	2.45	2.35
13	4.3	6.3	6.45	6.75	5.8	4.95	4.25	3.65	3.05	2.7	2.4	2.35
14	4.5	6.3	6.2	6.6	5.75	4.95	4.25	3.6	3.05	2.7	2.4	2.35
15	4.5	6.2	6.2	6.65	5.75	4.9	4.2	3.6	3.05	2.7	2.4	2.45
16	4.7	6.2	6.3	6.55	5.8	4.9	4.15	3.6	3.0	2.7	2.4	2.45
17	4.75	6.3	6.4	6.45	5.7	4.85	4.15	3.55	3.0	2.65	2.4	2.35
18	4.75	6.3	6.3	6.4	5.7	4.85	4.1	3.55	3.0	2.65	2.4	2.45
19	4.8	7.0	6.6	6.5	5.7	4.8	4.1	3.5	2.95	2.6	2.4	2.5
20	4.8	6.3	6.55	6.3	5.6	4.8	4.1	3.5	2.95	2.6	2.5	2.5
21	4.9	6.3	6.7	6.35	5.6	4.75	4.05	3.5	2.9	2.6	2.35	2.45
22	5.85	6.35	6.8	6.35	5.5	4.75	4.05	3.45	2.9	2.6	2.4	2.4
23	5.55	6.35	6.8	6.3	5.5	4.75	4.0	3.45	2.9	2.6	2.25	2.5
24	5.7	6.3	6.95	6.25	5.5	4.7	4.0	3.45	2.9	2.6	2.3	2.5
25	5.65	6.25	6.95	6.25	5.45	4.7	4.0	3.4	2.9	2.6	2.3	2.5
26	5.65	6.25	7.1	6.2	5.4	4.65	4.0	3.4	2.9	2.6	2.35	2.5
27	5.75	6.2	6.95	6.2	5.4	4.6	4.0	3.35	2.9	2.6	2.3	2.45
28	5.8	6.2	6.75	6.15	5.4	4.6	3.95	3.35	2.85	2.55	2.65	2.4
29	5.8	.....	7.2	6.1	5.4	4.55	3.9	3.35	2.85	2.55	2.5	2.4
30	5.8	.....	7.2	6.05	5.45	4.5	3.9	3.3	2.8	2.55	2.5	2.5
31	5.8	.....	7.1	.....	5.4	.....	3.85	3.3	.....	2.5	.....	2.55

Station rating table for Cache Creek at Lower Lake, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	17	3.40	149	4.50	365	5.60	670
2.40	27	3.50	163	4.60	390	5.70	701
2.50	37	3.60	178	4.70	416	5.80	732
2.60	48	3.70	194	4.80	442	5.90	763
2.70	59	3.80	212	4.90	469	6.00	795
2.80	71	3.90	232	5.00	496	6.20	859
2.90	83	4.00	252	5.10	524	6.40	923
3.00	95	4.10	274	5.20	552	6.60	988
3.10	108	4.20	296	5.30	581	6.80	1,054
3.20	121	4.30	318	5.40	610	7.00	1,120
3.30	135	4.40	341	5.50	640	7.20	1,188

NOTE.—The above table is based on 28 discharge measurements made during 1905 and during the latter part of 1904. It is well defined throughout.

Estimated monthly discharge of Cache Creek near Lower Lake, Cal., for 1905.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	748	274	448	27,550	0.896	1.03
February	1,120	562	884	49,100	1.77	1.84
March	1,188	610	933	57,370	1.87	2.16
April	1,222	811	991	58,970	1.98	2.21
May	811	610	702	43,160	1.40	1.61
June	581	365	476	28,320	.952	1.06
July	365	222	294	18,080	.588	.678
August	212	135	173	10,640	.346	.399
September	128	71	98.5	5,861	.197	.220
October	71	37	56.0	3,443	.112	.129
November	54	12	30.1	1,791	.060	.067
December	42	22	30.7	1,888	.061	.070
The year	1,222	12	426	306,200	.853	11.47

CACHE CREEK NEAR YOLO, CAL.

This station was established January 1, 1903, by S. G. Bennett. It is located at the wagon bridge on the road from Woodland to Yolo, about 1,000 feet above the Southern Pacific Railroad bridge. A new wagon bridge, which greatly improves the channel conditions, was erected during 1904. The station was reestablished on the new bridge December 4, 1904.

Numerous diversions are made from Cache Creek above this station which take practically all of the summer flow. The channel is straight for 1,000 feet above and below the station. The current is swift at ordinary and high stages. The banks are steep and wooded and their height has been increased by levees. They are said to overflow at extreme high water. The bed of the stream is composed of earth and gravel, with a little sand, and is not subject to any material change.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the end of the bridge on the right bank.

The gage is a staff in four sections, three of which are above the bridge and the fourth is bolted to the face of the concrete abutment on the right bank. During 1905 the gage was read by John Woodard. The bench mark is corner of top of concrete abutment to which the high-water section of gage is fastened and directly over gage; elevation, 31.68 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Cache Creek near Yolo, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
February 2	O W. Peterson	114	1,255	6.07	11.75	7,624
February 3	do	107	833	5.83	8.30	4,860
Do	do	108	890	5.87	8.80	5,227
February 4	do	102	630	6.03	7.05	3,802
February 15	do	94	345	4.39	4.85	1,516
May 16	W. B. Clapp	91	275	3.73	4.05	1,027
June 5	Peterson and Rodman	89	215	3.25	3.40	699
June 24	O. W. Peterson	89	151	2.37	2.60	358
August 3	do	87	88	1.47	1.79	129
September 7	C. H. Lee	32	19	.67	1.26	13.0
September 13	W. B. Clapp	17	7.3	.64	1.15	4.7
October 3	Lee and Hawley	2	.5	.80	1.09	.4

Daily gage height, in feet, of Cache Creek near Yolo, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	5.0	6.0	4.7	5.9	4.2	3.6	2.55	1.8	1.4	1.0
2	4.05	12.4	4.6	5.8	4.2	3.6	2.5	1.8	1.4	1.0
3	3.65	9.05	4.6	5.7	4.2	3.5	2.5	1.75	1.4	1.0
4	3.45	7.35	4.5	5.6	4.15	3.5	2.5	1.75	1.35	1.1
5	3.25	6.4	4.5	5.5	4.15	3.45	2.45	1.7	1.3	1.1
6	3.1	6.0	4.45	5.4	4.15	3.4	2.45	1.7	1.3	1.1
7	3.1	5.6	4.4	5.3	4.1	3.35	2.4	1.7	1.25	1.1
8	3.05	5.35	4.4	5.2	4.75	3.3	2.4	1.75	1.25	1.1
9	3.0	5.2	4.35	5.2	4.5	3.25	2.4	1.8	1.2	1.1
10	3.0	5.1	4.35	5.1	4.4	3.2	2.35	1.8	1.15	1.05
11	3.0	5.0	4.3	5.1	4.3	3.15	2.3	1.75	1.15	1.05
12	2.95	4.95	4.3	5.05	4.25	3.1	2.25	1.75	1.1	1.05
13	3.2	4.9	5.65	5.0	4.2	3.1	2.2	1.7	1.1	1.1
14	9.95	4.8	6.05	5.0	4.2	3.05	2.2	1.7	1.1	1.1
15	6.4	4.8	5.85	4.9	4.15	3.05	2.15	1.65	1.15	1.1
16	5.3	4.75	6.4	4.9	4.15	3.0	2.15	1.65	1.1	1.1
17	7.4	5.3	6.2	4.85	4.1	3.0	2.1	1.65	1.1	.....
18	7.0	5.25	5.7	4.8	4.1	3.0	2.1	1.6	1.1	.....
19	6.55	5.2	6.0	4.75	4.1	2.95	2.0	1.6	1.15	.....
20	5.3	5.1	6.0	4.7	4.05	2.9	2.0	1.6	1.15	.....
21	5.05	5.0	5.95	4.65	4.05	2.9	1.95	1.6	1.1	.....
22	8.25	5.0	5.9	4.6	4.0	2.85	1.9	1.65	1.1	.....
23	15.55	4.95	6.3	4.55	4.0	2.8	1.9	1.55	1.05	.....
24	8.8	4.9	6.2	4.5	3.95	2.8	1.85	1.55	1.05	.....
25	9.25	4.85	6.1	4.45	3.95	2.75	1.8	1.55	1.05	.....
26	7.0	4.8	6.05	4.4	3.9	2.7	1.8	1.5	1.05	.....
27	6.2	4.8	6.0	4.35	3.9	2.7	1.75	1.5	1.05	.....
28	5.8	4.7	5.9	4.3	3.8	2.65	1.75	1.5	1.05	.....
29	5.4	.....	7.1	4.25	3.8	2.6	1.6	1.45	1.0	.....
30	5.15	.....	6.85	4.2	3.7	2.6	1.6	1.45	1.0	.....
31	5.0	.....	6.1	.....	3.7	.....	1.6	1.4	.....	.....

NOTE.—Creek dry October 17 to December 31.

Station rating table for Cache Creek near Yolo, Cal., from January 1, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	0	2.60	361	4.40	1,230	7.60	3,635
1.10	1	2.70	395	4.60	1,350	7.80	3,815
1.20	7	2.80	430	4.80	1,480	8.00	4,000
1.30	17	2.90	467	5.00	1,610	8.50	4,475
1.40	32	3.00	505	5.20	1,745	9.00	4,970
1.50	53	3.10	550	5.40	1,885	9.50	5,470
1.60	76	3.20	595	5.60	2,025	10.00	5,980
1.70	100	3.30	640	5.80	2,170	10.50	6,505
1.80	125	3.40	690	6.00	2,320	11.00	7,050
1.90	151	3.50	740	6.20	2,470	11.50	7,600
2.00	178	3.60	790	6.40	2,625	12.00	8,150
2.10	206	3.70	840	6.60	2,785	13.00	9,300
2.20	235	3.80	890	6.80	2,945	14.00	10,500
2.30	265	3.90	945	7.00	3,110	15.00	11,700
2.40	296	4.00	1,000	7.20	3,280	16.00	12,950
2.50	328	4.20	1,110	7.40	3,455		

NOTE.—The above table is based on 12 discharge measurements made during 1905. It is well defined between gage heights 0 and 5 feet.

Estimated monthly discharge of Cache Creek near Yolo, Cal., for 1905.

[Drainage area, 1,280 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	12,390	486	2,313	142,200	1.81	2.09
February	8,610	1,415	2,142	119,000	1.67	1.74
March	3,195	1,170	1,969	121,100	1.54	1.78
April	2,245	1,110	1,576	93,780	1.23	1.37
May	1,448	840	1,058	65,050	.827	.953
June	790	361	542	32,250	.423	.472
July	344	76	214	13,160	.167	.192
August	125	32	86.5	5,319	.068	.078
September	32	0	7.1	423	.0055	.0061
October	1	0	.32	20	.00025	.00029
November	0	0	0	0	0	0
December	0	0	0	0	0	0
The year	12,390	0	826	592,300	.645	8.68

NOTE.—Estimates January 1 to February 10 are subject to considerable error owing to the scouring and filling at this section during high water.

MISCELLANEOUS MEASUREMENTS IN CACHE CREEK DRAINAGE BASIN.

Clover Creek near Upper Lake, Cal.—This stream discharges into Clear Lake. A measurement was made July 12 by O. W. Peterson, one-third of a mile above town of Upper Lake.

Width, 9.2 feet; area, 5.5 square feet; mean velocity, 0.49 foot per second; discharge, 2.7 second-feet.

Cole Creek at Kelseyville, Cal.—This stream discharges into Clear Lake. A measurement was made July 11, 1905, by O. W. Peterson, near Kelseyville and Lower Lake road, three-fourths of a mile below Kelseyville.

Width, 11.5 feet; area, 4.3 square feet; mean velocity, 1.00 foot per second; discharge, 4.3 second-feet.

Capay ditch at Capay, Cal.—This ditch diverts water from Cache Creek. The following measurements were made at head of ditch at Capay by O. W. Peterson.

June 19: Width, 18.8 feet; area, 34 square feet; mean velocity, 1.80 feet per second; discharge, 61 second-feet.

August 2: Width, 18.8 feet; area, 21 square feet; mean velocity, 1.57 feet per second; gage-height, 1.10 feet; discharge, 33 second-feet.

Kelsey Creek near Kelseyville, Cal.—This stream discharges into Clear Lake. A measurement was made July 11 by O. W. Peterson, 1¼ miles above Kelsey Creek Mill, about 3½ miles above the town of Kelseyville.

Width, 16.5 feet; area, 9 square feet; mean velocity, 1.29 feet per second; discharge, 11.6 second-feet.

Middle Creek near Upper Lake, Cal.—This stream discharges into Clear Lake. A measurement was made July 12 by O. W. Peterson, 1½ miles above the town of Upper Lake in sec. 31, T. 15 N, R. 9 W, M. D. M.

Width, 9.9 feet; area, 8.3 square feet; mean velocity, 0.48 foot per second; discharge, 4.0 second-feet.

Moore's ditch near Woodland, Cal.—The following measurements were made at Walker Bridge, one-half mile below canal heading:

June 3: Width, 21.6 feet; area, 89 square feet; mean velocity, 0.90 foot per second; discharge, 80 second-feet.

June 3: Width, 20 feet; area, 102 square feet; mean velocity, 1.69 feet per second; discharge, 172 second-feet.

June 17: Width, 24.5 feet; area, 72 square feet; mean velocity, 0.83 foot per second; gage height, 4.20 feet; discharge, 60 second-feet.

June 17: Width, 26 feet; area, 89 square feet; mean velocity, 1.13 feet per second; gage height, 4.80 feet; discharge, 101 second-feet.

June 17: Width, 35 feet; area, 119 square feet; mean velocity, 1.36 feet per second; gage height, 5.55 feet; discharge, 162 second-feet.

June 21: Width, 25.2 feet; area, 74 square feet; mean velocity, 1.65 feet per second; gage height, 5.45 feet; discharge, 122 second-feet.

August 2: Width, 19.8 feet; area, 87 square feet; mean velocity, 1.14 feet per second; gage height, 4.40 feet; discharge, 99 second-feet.

AMERICAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

American River drains an area of about 2,000 square miles of the western slope of the Sierra Nevada. This drainage basin lies between those of the Bear and Yuba rivers on the north and that of Consumnes River on the south. It has three main forks, heading in the summit of the range, which reaches an elevation of about 9,000 feet. The country lying between these main forks is drained by numerous small tributaries. The formation in the higher and greater portions of this basin is of granite, with a considerable timber

growth. The flow is rather torrential during the winter months, due to the large area of barren and sparsely timbered country in the lower portion of the watershed. The precipitation on the higher elevations is in the form of snow, which usually melts late in the spring. Rainfall records have been kept along the line of the Central Pacific Railroad, which follows the ridge to the north of North Fork.

The mean annual rainfall at Auburn is 33.40 inches, that at Colfax 47.4 inches, and at Cisco and Emigrant Gap about 50 inches. At Georgetown, between North and Middle forks, a 30-year record has an average of 56.72 inches, and at Placerville, above South Fork, another of about the same length shows 43.58 inches.

There are several small lakes in the upper reaches of this basin, the storage capacity of a few having been increased by the construction of low dams at their outlets. This stored water is used for mining purposes during the low-water flow and is used entirely within the drainage basin.

AMERICAN RIVER NEAR FAIROAKS, CAL.

This station was established November 3, 1904, by O. W. Peterson. It is located at Fairoaks Bridge, near Fairoaks.

The channel is straight for 400 feet above and below the station. At ordinary stages the velocity is sluggish. The right bank is not subject to overflow. At times of very high water the left bank is subject to overflow and a second channel is formed. The bed of the stream is composed of gravel, and is subject to slight changes at times of high water. At ordinary stages the river is about 210 feet in width and averages over 4 feet in depth.

Discharge measurements are made from the downstream side of the bridge. The vertical face of the right abutment is 4 feet from the initial point for soundings.

The gage is a staff nailed to one of the piles at the upper side at the right end of Fairoaks Bridge. During 1905 the gage was read twice each day by W. F. Bailey, jr. The bench mark is a nail driven in the guard rail over the upstream center pier; elevation, 31.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134 of the United States Geological Survey.

Discharge measurements of American River near Fairoaks, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 26	F. R. S. Buttemer	356	1,648	2.41	4.52	3,971
January 26	do	356	1,648	2.42	4.49	3,994
February 2	do	373	2,891	4.35	7.55	12,580
February 11	do	353	1,505	2.09	4.08	3,151
February 17	do	354	1,544	2.19	4.22	3,37[illegible]
February 22	do	355	1,776	2.67	4.90	4,74[illegible]
May 17	W. B. Clapp	370	2,864	4.34	7.35	12,34[illegible]
June 28	O. W. Peterson	260	993	1.53	2.88	1,53[illegible]
July 29	Peterson and Lee	167	694	.56	1.46	392
September 4	C. H. Lee	165	599	.20	.88	119

Daily gage height, in feet, of American River near Fairoaks, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.1	4.25	4.6	5.95	6.0	4.6	2.85	1.4	0.9	0.95	0.95	1.35
2	5.25	7.6	4.6	6.15	6.1	4.55	2.75	1.4	.9	.9	.95	1.25
3	3.95	5.85	4.6	5.95	5.9	4.45	2.7	1.4	.9	.95	.95	1.2
4	3.65	5.05	4.55	6.0	5.6	4.55	2.7	1.4	.9	.95	.95	1.25
5	3.5	6.65	4.6	6.15	5.55	4.45	2.65	1.35	.85	.95	.95	1.1
6	3.35	5.5	4.6	6.0	5.5	5.1	2.6	1.35	.9	.95	.95	1.15
7	3.6	4.9	4.6	6.15	5.6	5.15	2.5	1.35	.9	.95	.95	1.2
8	3.6	4.45	4.6	5.75	5.55	5.2	2.5	1.35	.9	.9	.95	1.15
9	3.9	4.25	4.5	5.65	5.8	5.35	2.4	1.3	.85	.95	.95	1.15
10	3.1	4.2	4.3	5.8	5.5	4.6	2.3	1.3	.9	.9	1.0	1.15
11	3.0	4.1	4.45	5.5	5.2	4.7	2.2	1.3	.9	.95	1.0	1.0
12	3.0	4.05	4.6	5.65	5.2	4.6	2.15	1.3	.85	.95	1.0	1.0
13	2.95	3.85	4.8	4.85	5.0	4.35	2.05	1.3	.9	.95	1.0	.9
14	3.5	3.7	5.1	5.25	5.55	4.1	2.0	1.25	.9	.95	.95	.95
15	4.65	3.6	5.15	5.1	6.15	4.2	1.9	1.25	.9	1.0	.95	1.0
16	4.55	3.4	4.55	4.85	6.7	4.0	1.8	1.25	1.0	.95	1.0	1.1
17	3.9	4.35	4.75	4.7	6.95	3.85	1.8	1.25	.95	.95	1.05	1.1
18	3.85	4.25	4.9	4.55	6.65	3.8	1.7	1.25	1.0	.95	.9	1.15
19	3.95	4.15	10.5	4.65	6.5	3.8	1.65	1.2	.9	.95	1.0	1.2
20	3.9	6.15	7.45	4.9	6.4	3.8	1.6	1.2	.95	.95	1.05	1.1
21	4.1	5.2	7.1	5.4	5.95	3.85	1.55	1.2	.95	.95	1.0	1.05
22	4.8	4.85	6.7	6.5	5.3	3.55	1.5	1.2	.9	.95	1.15	1.05
23	6.85	4.6	6.1	7.4	5.5	3.7	1.5	1.2	.95	.95	1.0	1.2
24	6.4	4.5	6.55	8.85	5.7	3.3	1.5	1.1	.95	.95	1.15	1.3
25	5.4	4.55	6.3	7.65	6.1	3.15	1.45	1.1	.9	1.0	1.0	1.2
26	4.45	4.9	6.5	7.1	5.9	3.1	1.45	1.1	.9	.95	1.1	1.3
27	4.25	4.7	6.8	6.6	5.5	2.9	1.45	1.1	.95	.95	1.0	1.4
28	3.9	4.75	6.4	6.7	5.35	2.8	1.45	1.0	.95	1.0	1.4	1.4
29	3.8	.....	6.85	6.8	4.75	2.75	1.45	1.0	.95	.95	1.75	1.55
30	3.75	.....	6.35	6.75	4.5	2.7	1.4	1.0	.95	.95	1.5	1.7
31	3.85	.....	5.95	.....	4.15	.....	1.4	1.0	.....	.....	.....	1.45

NOTE.—Gage heights estimated July 2–28; July 30 to September 2; November 1–9.

Station rating table for American River near Fairoaks, Cal., from November 4 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.40	700	2.70	990	3.00	1,300	3.30	1,680
2.50	790	2.80	1,090	3.10	1,410		
2.60	890	2.90	1,190	3.20	1,540		

NOTE.—The above table is based on 2 discharge measurements made during 1904, and on the 1905 curve.

Station rating table for American River near Fairoaks, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	90	2.20	840	3.60	2,410	6.00	7,450
0.90	120	2.30	920	3.70	2,555	6.20	8,040
1.00	155	2.40	1,005	3.80	2,705	6.40	8,670
1.10	195	2.50	1,095	3.90	2,860	6.60	9,340
1.20	240	2.60	1,195	4.00	3,020	6.80	10.040
1.30	285	2.70	1,300	4.20	3,365	7.00	10,770
1.40	335	2.80	1,410	4.40	3,730	7.20	11,530
1.50	390	2.90	1,525	4.60	4,115	7.40	12,310
1.60	445	3.00	1,640	4.80	4,520	7.60	13,090
1.70	505	3.10	1,760	5.00	4,950	7.80	13,890
1.80	565	3.20	1,880	5.20	5,405	8.00	14,700
1.90	630	3.30	2,005	5.40	5,880		
2.00	695	3.40	2,135	5.60	6,375		
2.10	765	3.50	2,270	5.80	6,900		

NOTE.—The above table is based on 10 discharge measurements made during 1905. It is fairly well defined between gage heights 0.8 foot and 5 feet.

Estimated monthly discharge of American River near Fairoaks, Cal., for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
November 4-30	1,355	700	896	47,980
December	13,600	700	1,404	86,330
1905.				
January	10,220	1,582	3,549	218,200
February	13,090	2,135	4,630	257,100
March	25,900	3,545	6,924	425,700
April	18,300	4,018	7,736	460,300
May	10,580	3,278	6,717	413,000
June	5,760	1,300	3,231	192,300
July	1,468	335	719	44,210
August	335	155	255	15,680
September	155	105	126	7,498
October	155	120	138	8,485
November	535	120	181	10,770
December	505	120	242	14,880
The year	25,900	105	2,874	2,068,000

MISCELLANEOUS MEASUREMENTS IN AMERICAN RIVER DRAINAGE BASIN.

South Fork of American River near Placerville, Cal.—A measurement was made August 20, 1905, at Chillie Bar, 3 miles north of Placerville and 400 yards upstream from wagon bridge, by H. A. Campbell. The distance to water surface from top of outer bar, of lower chord in the middle panel, on the upstream side of bridge was 23.5 feet.

Width, 28 feet; area, 42 square feet; mean velocity, 1.80 feet per second; discharge, 76 second-feet.

North Fork of the American River near Auburn, Cal.—A measurement was made about 400 yards above junction of North and Middle forks and about 2 miles northeast of Auburn on August 21, 1905, by H. A. Campbell.

Width, 28 feet; area, 44 square feet; mean velocity, 1.48 feet per second; discharge, 65 second-feet.

Middle Fork of the American River near Auburn, Cal.—A measurement was made on this stream about 400 yards above junction of the North and Middle forks and about 2 miles northeast of Auburn, Cal., on August 21, 1905, by H. A. Campbell.

Width, 55 feet; area, 101 square feet; mean velocity, 0.97 foot per second; discharge, 98 second-feet.

El Dorado ditch.—This ditch is taken out of South Fork of the American River about 1 mile below Slippery Ford. A measurement was made at the heading on August 24, 1905, by H. A. Campbell.

Width, 13.9 feet; area, 45 square feet; mean velocity, 1.24 feet per second; discharge, 56 second-feet.

Silver Fork of American River.—This stream enters South Fork of American River about 1 mile below Slippery Ford. A measurement was made on August 24, 1905, just above mouth, by H. A. Campbell.

Width, 11 feet; area, 18.3 square feet; mean velocity, 1.07 feet per second; discharge, 19.6 second-feet.

South Fork of American River.—A measurement was made one-fourth of a mile above Silver Fork and three-fourths mile below Slippery Ford on August 25, 1905, by H. A. Campbell.

Width, 26 feet; area, 63 square feet; mean velocity, 0.54 foot per second; discharge, 34 second-feet.

South Fork of Silver Creek.—A measurement was made on this stream August 26, 1905, about 200 feet above the mouth by H. A. Campbell.

Width, 16.5 feet; area, 21 square feet; mean velocity, 0.30 foot per second; discharge, 6.3 second-feet.

Silver Creek.—A measurement was made August 26, 1905, 100 feet above the mouth of South Fork of Silver Creek by H. A. Campbell.

Width, 11 feet; area, 16.2 square feet; mean velocity, 0.92 foot per second; discharge, 14.9 second-feet.

PUTA CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Puta Creek drains a portion of the eastern slope of the Coast Range, its waters discharging into Sacramento River through what is known as the Yolo basin in the vicinity of Davis, Cal. This basin is rather long and narrow, extending from west to east; it has numerous tributaries which have a heavy flood discharge during the winter months, but are practically dry during the summer. This stream is torrential in its flow. It has a comparatively small drainage basin with an exceptionally heavy rainfall, especially on the higher elevations in the vicinity of Mount St. Helena. A five-year rainfall record at Helen Mine on the northern slope of Mount St. Helena gives an average of 99.52 inches. The precipitation decreases as we approach the lower elevations. The upper reaches of this basin are well timbered, but the lower portion is comparatively barren of timber, though it has a considerable growth of brush extending to a point where the stream leaves the foothills. The areas in the lower portion of the basin are used principally for pasturage. The topography of the country is rough and precipitous. The underlying rock is an impervious slate and serpentine with a thin soil covering. There is comparatively little tilled land in this drainage basin above the point where the stream emerges from the foothills at Winters. Below this point the soil is deep and susceptible to high cultivation, and at present is used for the raising of grain and fruit.

PUTA CREEK NEAR GUENOC, CAL.

This station was established February 12, 1904. It is located about 2 miles below the old town of Guenoc, near the Asbill ranch house and at the Guenoc dam site. The nearest post-office is at Middletown, Cal.

The bed of the stream is gravelly, with a few bowlders above and below the section. Bed rock is laid bare on the right side of the channel. The left bank is high and rocky, while the right bank is rather low and flat and subject to overflow in very high water. The velocity is moderate for ordinary stages of flow, but high in flood periods. The range is about 12 feet, representing discharges of from 7 to 17,000 second-feet. The channel is straight for several hundred feet upstream, but has several large bowlders in it. Downstream it is straight for about 100 feet. The section is located in a narrow gorge at the lower end of a long, flat valley, which is flooded during high water. The channel will not allow the water to run off through the gorge fast enough to prevent backwater forming during flood periods.

Meter measurements during high water are made from a car and cable. At first the cable was located directly opposite the ranch house, but as the location proved very unfavorable it was moved November 15, 1904, to a point about 1,000 feet below. It now has a clear span of about 200 feet. The initial point for soundings is the eyebolt to which the cable is fastened on the left bank. An auxiliary cable has been placed parallel to the large one, so that float measurements can be made in time of very high water. During low water measurements are made by wading.

The gage, which was established near the old section, is still read, although a new one was placed near the cable in its present position. The old gage is a staff in two sections, both being fastened to trees. The section which is read in low water is about 600 feet upstream from the ranch stable, and the high-water section is directly opposite the stable. The new rod is made similarly to the other one. Both sections are located a few feet above the cable. One is bolted to a large bowlder on the left bank and the other nailed to a tree on the right bank. During 1905 the gage was read once each day during ordinary stages and twice a day during high water by Miss Agnes Asbill. The bench mark is the top of the rock to which the low-water section of the new gage is fastened; elevation, 7.62 feet above the datum of the new gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Puta Creek near Guenoc, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 1	F. R. S. Buttemer	81	433	1.37	5.58	592
January 1	do	76	390	1.36	5.42	530
January 2	do	66	342	1.13	5.14	386
January 2[a]	do	66	321	1.12	5.12	359
January 3	do	66	322	0.90	4.94	289
January 4	do	64	316	0.78	4.82	247
January 14	do	110	624	2.94	7.04	1,834
January 15	do	95	478	1.83	5.96	876
January 16	do	94	429	2.04	5.86	875
January 16	do	95	467	2.08	5.98	972
July 8	O. W. Peterson	16	12	1.58	3.72	19
September 29	C. H. Lee	8	4.1	1.66	3.56	6.[illegible]

[a] Float measurement.

Daily gage height, in feet, of Puta Creek near Guenoc, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.8	7.0	4.5	5.2	4.3	[a] 4.0	3.6	3.6	3.6	3.7	3.6	3.6
2	[a] 6.0	6.5	4.4	5.2	4.3	4.0	3.7	3.6	3.6	3.7	3.6	3.6
3	[a] 5.4	6.2	4.3	5.2	4.3	3.9	3.7	3.6	3.6	3.7	3.6	3.6
4	4.8	6.0	4.2	5.1	4.4	5.4	3.7	3.6	3.6	3.7	3.6	3.6
5	4.7	6.3	4.4	5.1	4.3	5.6	3.7	3.6	3.6	3.7	3.6	3.6
6	4.4	6.0	4.4	5.1	4.3	5.0	3.7	3.6	3.6	3.7	3.6	3.6
7	4.4	5.8	4.3	5.0	5.0	4.2	3.7	3.6	3.6	3.7	3.6	3.6
8	4.5	5.5	4.3	5.0	5.2	4.2	3.7	3.6	[a] 3.6	3.7	3.6	3.6
9	4.7	5.4	4.2	5.1	4.8	4.1	3.7	3.6	3.6	3.7	3.6	3.6
10	4.6	5.1	4.2	5.1	4.6	4.1	3.7	[a] 3.6	3.6	3.7	3.6	3.6
11	4.5	5.0	4.2	5.0	4.4	4.0	3.7	3.6	3.6	3.7	3.6	3.6
12	4.5	4.9	4.5	5.0	4.4	4.0	3.7	3.6	[a] 3.6	3.7	3.6	3.6
13	6.1	4.8	5.5	5.0	4.4	3.9	3.7	3.6	3.6	3.7	3.6	3.6
14	7.45	4.7	6.5	5.0	4.4	3.9	3.7	3.5	3.6	3.7	3.6	3.6
15	5.9	4.6	6.0	5.1	4.3	3.9	3.6	3.5	3.6	[a] 3.7	3.6	3.7
16	5.9	4.9	6.2	5.2	4.3	3.9	3.6	3.5	3.6	3.7	3.6	3.8
17	4.4	5.1	6.0	5.2	4.3	3.9	3.6	3.5	3.6	3.7	3.6	3.8
18	4.5	5.4	6.5	5.1	4.2	3.8	3.6	3.5	[a] 3.6	3.7	3.6	3.8
19	6.45	6.3	6.85	5.0	4.2	3.8	3.5	3.5	3.6	3.7	3.6	3.8
20	5.4	6.0	6.1	4.9	4.2	3.8	3.5	3.6	3.6	3.7	3.6	3.8
21	6.8	5.9	5.9	4.9	4.2	3.8	3.5	[a] 3.6	3.6	3.6	3.6	3.7
22	13.5	5.7	5.8	4.8	4.1	3.8	3.5	3.6	3.6	3.6	3.6	3.7
23	8.9	5.4	5.8	4.8	4.1	3.8	3.5	3.6	3.6	3.6	3.6	3.7
24	7.2	5.2	5.7	4.7	4.1	3.8	3.6	3.6	3.6	3.6	3.6	4.0
25	6.7	5.0	5.4	4.6	4.1	3.7	3.6	3.6	3.6	3.6	3.6	4.1
26	6.0	4.8	5.0	4.5	4.0	3.7	3.6	3.6	3.6	3.6	3.6	3.9
27	5.9	4.7	5.8	4.4	4.0	3.7	[a] 3.6	3.6	3.6	3.6	3.6	3.9
28	5.7	4.6	5.8	4.3	4.0	3.7	3.6	3.6	3.6	3.6	3.6	[a] 3.9
29	5.6	.....	7.5	4.3	4.0	3.7	3.6	3.6	3.6	3.6	3.6	3.8
30	5.4	.....	5.8	[a] 4.3	4.0	3.6	3.6	3.6	3.6	3.6	[a] 3.6	3.8
31	5.8	.....	5.5	.....	4.0	.....	3.6	3.6	.....	3.6	.....	3.7

[a] Interpolated

Station rating table for Puta Creek near Guenoc, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.50	4	5.00	310	6.50	1,360	9.00	5,000
3.60	10	5.10	350	6.60	1,450	9.20	5,400
3.70	18	5.20	395	6.70	1,545	9.40	5,800
3.80	28	5.30	445	6.80	1,640	9.60	6,230
3.90	42	5.40	500	6.90	1,740	9.80	6,690
4.00	58	5.50	560	7.00	1,840	10.00	7,150
4.10	75	5.60	625	7.20	2,060	10.50	8,300
4.20	93	5.70	695	7.40	2,290	11.00	9,450
4.30	112	5.80	770	7.60	2,540	11.50	10,600
4.40	133	5.90	850	7.80	2,820	12.00	11,800
4.50	156	6.00	930	8.00	3,130	12.50	13,000
4.60	181	6.10	1,010	8.20	3,460	13.00	14,200
4.70	208	6.20	1,095	8.40	3,810	14.00	16,700
4.80	238	6.30	1,180	8.60	4,200		
4.90	272	6.40	1,270	8.80	4,600		

NOTE.—The above table is based on 17 discharge measurements made during 1904–5. It is well defined between gage heights 3.5 feet and 7 feet. Above 7 feet the table depends on 2 measurements at 12 feet and 13.7 feet. Above 9 feet the table is the same as for 1904.

Estimated monthly discharge of Puta Creek near Guenoc, Cal., for 1905.

[Drainage area, 91 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	15,450	133	1,344	82,640	14.77	17.03
February	1,840	181	619	34,380	6.80	7.08
March	1,690	93	630	38,740	6.92	7.98
April	395	112	288	17,140	3.16	3.53
May	395	58	120	7,379	1.32	1.52
June	625	10	85.0	5,058	.934	1.04
July	18	4	12.4	762	.136	.157
August	10	4	8.8	541	.097	.112
September	10	10	10.0	595	.110	.123
October	18	10	15.2	935	.167	.192
November	10	10	10.0	595	.110	.123
December	75	10	22.1	1,359	.243	.280
The year	15,450	4	264	190,100	2.90	39.17

PUTA CREEK AT WINTERS, CAL.

This station was established September 26, 1905, by R. S. Hawley. It is located about 450 feet below the Southern Pacific Railroad bridge and about 800 feet southeast of the depot at Winters, Cal.

The channel is straight for about 500 feet above and 700 feet below the cable section. The bed of the stream is composed of coarse gravel and is liable to some change at very high stages, but at ordinary stages it is not subject to much change. The current is sluggish at low water, but is swift during flood stages. There is a growth of willows and cottonwoods with wild grapevines along the banks, but the main portion of the channel is clear.

At very high flood stages the water spreads out over the left bank for about 150 feet, reaching nearly to the foot of the left cable support. At ordinary stages, however, the water remains within the high banks.

Measurements are made during low water by wading at a point about 400 feet above the bridge, but for higher stages a cable and car are used. The cable has a span of 280 feet. For float measurements, a course 250 feet long has been marked off by setting posts painted white, 250 feet above and parallel with the cable. Floats can be dropped from the railroad bridge above and timed from these posts to the cable. The initial point of soundings is a bolt in the trunk of the oak tree to which the cable is fastened on the right bank.

The gage consists of a series of timbers painted white and located under the cable. The first or low-water section is on the right bank, and is nailed vertically to the trunk of a cottonwood tree. It has a range of about 6 feet. The second section is on the left bank and is nailed vertically to the stump of a cottonwood tree. The third section is an inclined rod anchored on the left bank with posts. The fourth section is on an eucalyptus tree on top of left bank. During 1905 the gage was read once each day by Roy Wyatt. Bench marks were established as follows: (1) A standard United States Geological Survey bench mark, located 150 feet south of the depot. Its elevation as marked on the copper plate is 131 feet, 39.23 feet above the datum of the gage. (2) A square-headed bolt in concrete, 3 feet south of the left cable support; elevation, 37.27 feet above the datum of the gage.

Discharge measurements of Puta Creek at Winters, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
September 12	W. B. Clapp	16	8.0	1.09	.....	8.7
September 26	Hawley and Lee	16	8.8	.97	4.39	8.5
November 15	R. S. Hawley	16	8.8	1.33	4.42	11.7

Daily gage height, in feet, of Puta Creek at Winters, Cal., for 1905.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	4.4	4.4	4.6	17	.....	4.4	4.45	4.55
2	.....	4.4	4.4	4.65	18	.....	4.4	4.45	4.6
3	.....	4.4	4.4	4.6	19	.....	4.4	4.45	4.6
4	.....	4.4	4.4	4.6	20	.....	4.4	4.45	4.6
5	.....	4.4	4.4	4.6	21	.....	4.4	4.45	4.6
6	.....	4.4	4.4	4.6	22	.....	4.4	4.45	4.6
7	.....	4.4	4.4	4.55	23	.....	4.4	4.5	4.6
8	.....	4.4	4.4	4.55	24	.....	4.4	4.5	4.6
9	.....	4.4	4.4	4.55	25	.....	4.4	4.5	4.6
10	.....	4.4	4.4	4.5	26	4.4	4.4	4.5	4.6
11	.....	4.4	4.4	4.5	27	4.4	4.4	4.5	4.6
12	.....	4.4	4.45	4.5	28	4.4	4.4	4.5	4.6
13	.....	4.4	4.45	4.55	29	4.45	4.4	4.6	4.6
14	.....	4.4	4.45	4.55	30	4.4	4.4	4.6	4.6
15	.....	4.4	4.45	4.55	31	.....	4.4	.....	4.6
16	.....	4.4	4.45	4.55					

SAN JOAQUIN RIVER.

DESCRIPTION OF RIVER.

San Joaquin River is divided into two distinct parts. The valley portion forms the central drainage line of San Joaquin Valley, and during the spring is navigable for 100 miles or more. Stanislaus, Tuolumne, Merced, and Kings rivers are the largest streams in this portion of the drainage basin. The waters of Kings, Kaweah, Tule, and Kern rivers, which are located in the portion of San Joaquin Valley lying to the south and east of Fresno, although forming a portion of the drainage of San Joaquin River, seldom reach this stream. Their entire flow, except in extreme flood, is diverted and used for irrigation at points where they emerge from the foothills. The valley is fertile and almost destitute of timber. The mountainous portion of the stream drains the western slope of the Sierra Nevada between the Merced River on the north and Kings River on the south, the crest of its divide reaching an elevation of 13,000 feet in Mount Lyell and an elevation of 14,000 feet in Mount Goddard. There are numerous tributaries in this portion of the drainage basin, many of which have their source in the high elevations. The formation is of granite, which in the upper reaches is bare and sharply marked by glacial action. The middle reaches of the basin are well timbered, the timber diminishing on the lower foothills, which have a covering of brush and grass. The precipitation takes the form of snow on the higher elevations. The fall of the river is rapid, with many favorable locations for power development. There are numerous lakes in the upper reaches of the basin. A storage reservoir has been constructed on North Fork, which will tend to further regulate the flow of the river.

SAN JOAQUIN RIVER AT HERNDON, CAL.

The gage rod at this station was established by the engineering department of the Southern Pacific Railroad Company in 1879. The old trestle bridge was torn down by the railroad company during 1899 and a new iron structure was erected in its place. A new gage rod, set to the datum of the old gage, was bolted to the western side of the central concrete pier. The bench mark is a nail in a post at the south end of the bridge on the west side, 0.2 foot above the ground, and marked "B. M." It is at an elevation of 24.12 feet above gage datum.

The channel for some distance above and below the bridge is straight, and the water has a uniform velocity. The right bank is high, rocky, and steep. The bed of the stream is composed of small gravel and shifting sand. Because of the continual changes in the cross section, which were increased by a side channel breaking through the gravel pits on the left bank of the river just above the gaging station, meter measurements were discontinued at this station at the end of 1901.

The river stage record for 1905 has been furnished by William Hood, chief engineer of the Southern Pacific Railroad Company. G. G. Nelson was the observer.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Daily gage height, in feet, of San Joaquin River at Herndon, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.0	3.9	4.5	7.0	6.75	6.1	3.5	3.15	2.5	2.4	2.6
2	3.5	3.15	4.1	4.5	6.75	6.6	6.0	3.5	3.1	2.5	2.4	2.65
3	3.3	4.6	4.25	4.5	6.6	6.6	5.75	3.5	3.0	2.5	2.4	2.65
4	3.25	4.4	4.25	4.5	6.0	6.75	6.0	3.5	3.0	2.5	2.4	2.6
5	3.15	4.3	4.25	5.0	5.5	6.75	6.0	3.5	2.9	2.5	2.4	2.6
6	3.15	4.75	4.15	5.25	5.5	6.4	5.75	3.5	2.75	2.5	2.4	2.6
7	3.15	4.5	4.15	5.3	5.65	6.3	5.5	3.4	2.75	2.5	2.4	2.6
8	3.15	4.0	4.25	5.5	5.65	7.15	5.3	3.4	2.75	2.5	2.4	2.6
9	3.1	3.75	4.3	6.65	6.0	7.4	5.3	3.4	2.75	2.5	2.4	2.5
10	3.1	3.5	4.3	5.75	5.5	7.4	5.2	3.4	2.75	2.5	2.4	2.5
11	3.1	3.5	4.5	5.5	5.5	7.5	5.15	3.4	2.75	2.5	2.4	2.5
12	3.1	3.5	4.5	5.5	5.5	8.3	5.1	3.3	2.75	2.5	2.4	2.5
13	3.1	3.4	4.5	5.3	5.5	8.75	5.0	3.3	2.75	2.5	2.4	2.5
14	3.1	3.3	7.15	4.75	5.5	8.0	4.75	3.3	2.65	2.5	2.4	2.5
15	3.1	3.3	5.5	4.7	6.0	8.0	4.75	3.3	2.65	2.5	2.4	2.5
16	3.3	3.25	5.0	5.1	7.0	7.75	4.65	3.25	2.65	2.5	2.4	2.5
17	3.15	3.15	5.0	5.25	8.5	8.0	4.65	3.25	2.65	2.5	2.4	2.5
18	3.1	3.15	5.0	5.0	8.75	8.25	4.65	3.25	2.65	2.5	2.4	2.5
19	3.0	3.15	5.0	5.0	9.65	8.75	4.65	3.25	2.65	2.5	2.4	2.5
20	3.0	3.15	6.5	5.0	8.25	8.3	4.5	3.25	2.65	2.5	2.4	2.6
21	3.0	3.15	5.0	4.75	8.6	7.75	4.5	3.25	2.65	2.5	2.4	2.75
22	3.0	3.15	5.0	5.0	8.25	8.0	4.5	3.25	2.65	2.5	2.4	2.75
23	3.0	3.15	5.0	5.0	8.3	7.5	4.5	3.15	2.65	2.5	2.4	2.75
24	3.0	3.15	5.0	5.0	8.1	7.15	4.3	3.15	2.6	2.4	2.4	2.75
25	3.0	3.15	5.0	5.0	8.25	6.5	4.3	3.15	2.6	2.4	2.4	2.75
26	3.0	3.15	5.0	5.5	8.5	6.65	4.3	3.15	2.6	2.4	2.4	2.75
27	3.0	3.15	5.25	5.5	8.3	6.5	4.25	3.15	2.6	2.4	2.4	2.75
28	3.0	3.15	5.0	6.0	7.65	6.5	4.0	3.15	2.6	2.4	2.4	2.75
29	3.0	.....	5.0	6.0	7.65	6.5	3.75	3.15	2.6	2.4	2.4	2.75
30	3.0	.....	4.75	6.15	6.6	6.6	3.6	3.15	2.6	2.4	2.4	2.75
31	3.0	.....	4.7	.....	6.75	.....	3.6	3.15	.....	2.4	2.6	2.65

NOTE.—Gage heights reduced to feet and tenths from feet and inches as furnished by Southern Pacific Railroad Company.

MISCELLANEOUS MEASUREMENTS IN SAN JOAQUIN RIVER DRAINAGE BASIN.

Pitman Creek.—This stream is tributary to the San Joaquin River through Big Creek. An estimate was made of the discharge below the mouth of Tamarack Creek on September 2, 1905, by R. S. Hawley.

Discharge, 1.5 second-feet.

Home Camp Creek.—This stream is tributary to the San Joaquin River through Big Creek, which it enters at Home Camp meadow. A measurement was made on this creek on September 2, 1905, 100 feet above its mouth, by R. S. Hawley.

Width, 3.0 feet; area, 0.8 square foot; mean velocity, 1.12 feet per second; discharge, 0.90 second-foot.

Big Creek.—This stream is tributary to San Joaquin River from the east. A measurement was made 100 feet above the mouth of Home Camp Creek on September 2, 1905, by R. S. Hawley.

Width, 4.5 feet; area, 1.9 square feet; mean velocity, 2.53 feet per second; discharge, 4.8 second-feet.

Discharge below the mouth of Home Camp Creek was 5.7 second-feet.

Small Creek.—This is a small creek which enters the South Fork of the San Joaquin from the south at Mono crossing. A measurement was made at the Mono trail crossing about 1,000 feet above its mouth on September 4, 1905, by R. S. Hawley.

Width, 2.8 feet; area, 1.1 square feet; mean velocity, 1.18 feet per second; discharge, 1.3 second-feet.

South Fork of San Joaquin River.—This is the principal tributary of the San Joaquin River from the south. A measurement was made September 4, 1905, at the Mono crossing by R. S. Hawley.

Width, 60 feet; area, 94 square feet; mean velocity, 1.11 feet per second; discharge, 104 second-feet.

Mono Creek.—This stream is tributary to South Fork of San Joaquin River from the east. A measurement was made at the Mono Trail crossing, about 2 miles above its mouth, on September 4, 1905, by R. S. Hawley.

Width, 44.5 feet; area, 37 square feet; mean velocity, 1.17 feet per second; discharge, 43 second-feet.

Fish Creek.—This stream is the principal tributary of the Middle Fork of the San Joaquin from the south about 10 miles above the junction of the Middle and South forks. A measurement was made on September 6, 1905, at the trail crossing, about 3 miles above its mouth, by R. S. Hawley.

Width, 29 feet; area, 36 square feet; mean velocity, 1.42 feet per second; discharge, 51 second-feet.

Middle Fork of San Joaquin River.—This stream drains the northeastern portion of the San Joaquin watershed. A measurement was made on September 6, 1905, at the Devils Post Pile at the trail crossing by R. S. Hawley.

Width, 42 feet; area, 41 square feet; mean velocity, 0.90 foot per second; discharge, 37 second-feet.

Reds Creek.—This stream enters Middle Fork of San Joaquin River one-half mile below the Devils Post Pile. A measurement was made September 6, 1905, at the Mammoth trail crossing, one-fourth mile above its mouth, by R. S. Hawley.

Width, 9 feet; area, 4.2 square feet; mean velocity, 0.93 foot per second; discharge, 3.9 second-feet.

King Creek.—This stream enters Middle Fork of San Joaquin River near Rainbow Falls. An estimate was made of the discharge one mile above its mouth, at Mammoth trail crossing, on September 7, 1905, by R. S. Hawley.

Discharge, 3.5 second-feet.

Mugler Creek.—This stream enters the San Joaquin River from the north. On September 7, 1905, an estimate of the discharge was made at the trail crossing, one-half mile below Mugler Meadow, by R. S. Hawley.

Discharge, 3.0 second-feet.

Stevenson Creek.—This stream enters the San Joaquin River 4 miles northwest of Shaver post-office. A measurement was made one-fourth mile above the head of Shaver Lake on September 2, 1905, by R. S. Hawley.

Width, 8 feet; area, 3.2 square feet; mean velocity, 1.22 feet per second; discharge, 3.9 second-feet.

North Fork of the San Joaquin River.—This stream enters the San Joaquin River 4 miles below the junction of the Middle and South forks. A measurement was made on September 7, 1905, 150 feet below the bridge, at the trail crossing, 3 miles above its mouth.

Width, 31 feet; area, 27 square feet; mean velocity, 1.33 feet per second; discharge, 36 second-feet.

North Fork of Willow Creek.—This stream enters the San Joaquin from the north. A measurement was made on September 9, 1905, at "The Pines," 1½ miles above reservoir dam, by R. S. Hawley.

Width, 7 feet; area, 3.6 square feet; mean velocity, 1.19 feet per second; discharge, 4.3 second-feet.

San Joaquin River at the San Joaquin power house.—A measurement was made on this stream on September 9, 1905, one-half mile below the power house, by R. S. Hawley. This measurement includes practically the total flow from the whole drainage area of the San Joaquin River about this point.

Width, 148.5 feet; area, 226 square feet; mean velocity, 1.37 feet per second; discharge, 310 second-feet.

KERN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kern River drains 2,345 square miles of the western slope of the Sierra Nevada at its extreme southern limits. This drainage basin is the largest of any stream discharging into the San Joaquin Valley, it having an area 600 square miles greater than that of the Kings River. It has its source in the highest elevations of the Sierra Nevada, draining the western and southern slopes of Mount Whitney and numerous other high granite peaks grouped about it, which reach elevations of over 14,000 feet. Its general direction is south for about 65 miles when it turns and flows in a southwesterly direction, discharging into the San Joaquin Valley east of Bakersfield, Cal. Extending, as it does in its upper reaches, for some distance parallel with the Sierra Nevada, it receives waters not only from the main crest on the east, but also from a somewhat lower divide on the west behind the basins of the Kaweah and Tule rivers. It has numerous tributaries, the principal ones entering from the east, which drain the higher elevations of the main crest of the Sierra Nevada. The topography is extremely rough and broken in the upper reaches of this basin, becoming less rugged in the middle portion in the vicinity of Kernville, where there is quite an extensive valley with considerable cultivated land; below this point the stream enters a rough canyon, finally discharging into the flat country of the San Joaquin Valley. The entire flow, except during extreme flood stages, is diverted and used for irrigation at points where streams emerge from the foothills.

The formation is of granite, which, above the 10,000-foot contour, is practically bare of timber growth. Between elevations of 3,000 and 10,000 feet there is a good depth of soil, with timber and brush covering; the lower reaches have a light covering of brush and grass.

There are several lakes and marshes scattered throughout this basin, but they are less numerous than in the basins farther to the north. Several power plants are located on this stream, none of which, however, receive water from storage reservoirs, the diversions being made from the natural flow of the river and again returned to the river channel. The precipitation is very light throughout this basin, with the possible exception of the high elevations surrounding Mount Whitney, where the snow remains through the summer months.

KERN RIVER NEAR BAKERSFIELD, CAL.

This station, established in 1893 by Walter James, chief engineer of the Kern County Land Company, is located at what is known as "first point of measurement," 5 miles above Bakersfield and at the mouth of the canyon of the river.

Regular meter measurements are taken, and an automatic gage records daily fluctuations of the river heights. A. K. Warren, the engineer in charge of this work for the Kern County Land Company, attends to the discharge measurements with accuracy and precision and furnishes the Geological Survey with the final results.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Daily discharge, in second-feet, of Kern River near Bakersfield, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	280	305	435	799	1,700	1,953	1,520	427	233	205	230	262
2	285	326	458	848	1,713	1,979	1,422	413	229	226	227	261
3	272	435	480	934	1,743	1,932	1,313	403	224	227	221	276
4	278	486	500	997	1,633	1,931	1,226	394	213	208	218	285
5	290	517	512	1,047	1,542	1,919	1,215	376	216	196	215	277
6	281	503	530	1,070	1,517	1,879	1,218	362	215	190	216	271
7	269	452	545	1,103	1,453	1,997	1,171	345	217	181	231	267
8	272	391	593	1,138	1,531	2,154	1,157	356	220	175	217	275
9	270	364	616	1,185	1,461	2,150	1,115	358	218	176	225	278
10	276	365	609	1,119	1,418	2,066	1,130	351	207	186	227	284
11	280	351	613	1,186	1,367	2,200	1,125	349	202	192	230	284
12	272	338	631	1,180	1,300	2,567	1,092	349	208	199	232	275
13	266	334	785	1,052	1,298	2,923	1,038	352	218	206	233	265
14	246	317	1,154	971	1,317	2,978	958	352	225	206	228	241
15	255	317	974	952	1,425	3,039	886	345	221	202	223	244
16	255	361	996	991	1,649	2,933	799	338	218	199	234	240
17	260	398	1,143	995	1,949	2,948	748	327	215	203	240	238
18	269	434	1,140	1,052	2,312	2,747	717	319	215	194	257	246
19	277	417	1,009	1,121	2,359	2,569	665	318	208	198	263	259
20	273	413	1,309	1,058	2,528	2,555	628	308	203	215	262	266
21	305	401	1,073	992	2,549	2,547	634	286	197	218	247	265
22	329	386	957	964	2,625	2,539	597	279	194	217	243	272
23	343	390	888	920	2,558	2,408	578	267	195	221	239	255
24	311	397	871	895	2,412	2,154	558	269	196	230	227	233
25	301	410	900	936	2,456	1,835	557	286	201	226	237	221
26	298	420	929	1,033	2,560	1,690	548	285	204	218	239	239
27	281	432	999	1,070	2,598	1,685	536	282	214	217	253	255
28	276	434	978	1,067	2,378	1,617	532	271	200	221	259	262
29	271	.....	919	1,157	2,120	1,584	520	270	205	222	263	271
30	276	.....	1,051	1,451	1,962	1,563	488	265	205	224	245	255
31	284	.....	913	.....	1,930	.....	451	250	.....	226	.....	257

Estimated monthly discharge of Kern River near Bakersfield, Cal., for 1905.

[Drainage area, 2,345 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	343	246	281	17,280	0.120	0.138
February	517	305	396	21,990	.169	.176
March	1,309	435	823	50,600	.351	.405
April	1,451	799	1,043	62,060	.445	.496
May	2,625	1,298	1,915	117,800	.817	.942
June	3,039	1,563	2,235	133,000	.953	1.06
July	1,520	451	876	53,860	.374	.431
August	427	250	327	20,110	.139	.160
September	233	194	211	12,560	.090	.100
October	230	175	207	12,730	.088	.101
November	263	215	236	14,040	.101	.113
December	285	221	261	16,050	.111	.128
The year	3,039	175	734	532,100	.313	4.25

TULE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Tule River rises in the Sierra Nevada, and drains the country between the Kaweah River on the north and the Kern River on the south and east. Its drainage area is much less than that of the Kaweah River, although of the same general character. It has numerous small tributaries, few of which have their source at elevations above 8,000 feet. Its drainage basin does not extend back to the main divide, being cut off by the Kern River, which reaches to the north and drains the higher portion of Sierra Nevada to the east of Tule River. There is good timber and brush covering on the higher and middle elevations, with grass and scattering timber on the lower elevations, where the soil is extensively cultivated. Below the gaging station the water is diverted by several canals and used for the irrigation of land in the vicinity of Portersville, which is especially adapted for the raising of citrus fruits, such as oranges and lemons. During the flood period the water discharges through an old channel, and either sinks in the sand or finds its way to the old bed of Tulare Lake.

The mean precipitation in this watershed is probably not more than 20 inches, and falls principally in the form of rain.

TULE RIVER NEAR PORTERSVILLE, CAL.

This station was established April 8, 1901. It is located about 8 miles east of Portersville near the McFarland ranch, 100 feet below wagon bridge and about 1 mile above the mouth of the South Fork of Tule River.

The channel is straight for 200 feet above and below the cable section. The right bank is high and not subject to overflow. The left bank is subject to overflow at flood stages. The bed of the stream is composed of gravel, with some large rocks, but is not subject to much change.

Discharge measurements during medium and high water are made from a car and cable; at low water measurements are made by wading.

The gage is a staff in two sections on the right bank under the cable The lower section is inclined and fastened to posts set in the ground. The higher section is vertical and nailed to the tree through which the cable passes. During 1905 the gage was read by Adah

McFarland. Bench marks were established as follows: (1) A cross on the top of a bowlder on the right bank of the river between the cable and the bridge; elevation, 13.10 feet. (2) A point marked with white paint on a dark granite bowlder 55 feet south of the rock pier of the bridge; elevation, 10.05 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Tule River near Portersville, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 22	F. R. S. Buttemer	71	107	2.05	2.50	219
May 19	R. S. Hawley	77	152	2.34	3.00	355
June 13	do	69	97	1.68	2.27	163
July 26	do	33	26	.96	1.16	25
September 18	C. H. Lee	26	17	.58	.92	10
September 26	Clapp and Holley	24	16	.50	.91	8.0
October 25	Hawley and Lee	30	22	.70	1.10	15.5

Daily gage height, in feet, of Tule River near Portersville, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.45	1.7	2.3	2.5	2.55	1.7	1.05	0.9	1.1	1.05	1.9
2	1.7	2.30	1.7	2.4	3.0	2.55	1.7	1.05	.9	1.05	1.1	1.85
3	1.65	2.0	1.75	2.5	2.9	2.5	1.65	1.05	.9	1.05	1.1	1.85
4	1.6	2.0	1.75	2.6	2.8	2.45	1.6	1.05	.9	1.0	1.1	1.8
5	1.6	1.9	1.75	2.55	2.5	2.45	1.55	1.05	.9	1.0	1.1	1.8
6	1.6	1.8	1.8	2.55	2.5	2.45	1.5	1.0	.9	1.0	1.1	1.8
7	1.55	1.75	1.8	2.55	3.05	2.4	1.45	1.0	.9	1.0	1.1	1.8
8	1.55	1.7	1.8	2.5	3.2	2.35	1.4	1.0	.9	1.0	1.15	1.8
9	1.5	1.65	1.75	2.5	2.95	2.35	1.4	1.0	.9	1.05	1.15	1.8
10	1.5	1.6	1.75	2.4	2.85	2.3	1.4	1.0	.95	1.05	1.15	1.8
11	1.5	1.6	1.7	2.35	2.8	2.3	1.4	1.0	.95	1.0	1.15	1.8
12	1.45	1.6	1.75	2.3	2.75	2.4	1.35	.95	.95	1.0	1.15	1.8
13	1.45	1.6	3.1	2.35	2.7	2.35	1.35	.95	.95	.95	1.15	1.8
14	1.4	1.6	2.8	2.35	2.9	2.3	1.3	.95	1.0	1.0	1.15	1.8
15	1.4	1.7	2.6	2.4	3.0	2.25	1.3	.95	.95	1.0	1.2	1.8
16	1.4	1.75	3.0	2.35	3.2	2.25	1.3	.95	.95	1.0	1.2	1.8
17	1.4	1.75	3.0	2.3	3.3	2.1	1.25	.95	.95	1.0	1.3	1.8
18	1.4	1.8	2.9	2.3	3.1	2.0	1.25	.95	.95	1.0	1.3	1.9
19	1.4	1.8	4.1	2.5	3.0	1.95	1.2	.95	.95	1.0	1.3	1.9
20	1.4	1.75	3.7	2.45	3.0	1.9	1.2	.95	.95	1.0	1.7	1.9
21	1.6	1.75	3.5	2.45	2.95	1.85	1.2	.95	.95	1.0	1.7	1.9
22	1.6	1.75	3.1	2.4	2.8	1.8	1.15	.95	.95	1.0	1.65	1.9
23	1.5	1.7	2.8	2.4	2.7	1.8	1.15	.95	.95	1.0	1.65	1.9
24	1.5	1.7	2.5	2.35	2.75	1.8	1.1	.95	.95	1.0	1.65	1.85
25	1.5	1.7	2.3	2.4	2.8	1.9	1.1	.95	.95	1.0	1.6	1.85
26	1.5	1.7	2.3	2.4	2.8	1.85	1.15	.95	.95	1.0	1.6	1.9
27	1.5	1.7	2.3	2.45	2.8	1.85	1.1	.95	.95	1.0	2.1	2.0
28	1.5	1.7	2.25	2.5	2.75	1.8	1.1	.9	1.0	1.0	1.95	2.0
29	1.5	.....	2.9	2.6	2.7	1.8	1.15	.9	1.0	1.0	1.85	2.1
30	1.45	.....	2.4	2.7	2.65	1.75	1.05	.9	1.0	1.05	1.9	2.1
31	1.4	.....	2.3	.....	2.6	.....	1.05	.9	.....	1.05	.....	2.1

Station rating table for Tule River near Portersville, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.90	7	1.80	82	2.70	270	3.60	581
1.00	12	1.90	98	2.80	297	3.70	626
1.10	18	2.00	115	2.90	325	3.80	672
1.20	24	2.10	133	3.00	355	3.90	720
1.30	31	2.20	152	3.10	386	4.00	770
1.40	38	2.30	173	3.20	419	4.10	822
1.50	46	2.40	195	3.30	455		
1.60	56	2.50	219	3.40	494		
1.70	68	2.60	244	3.50	537		

NOTE.—The above table is based on seven discharge measurements made during 1905. It is well defined between gage heights 0.9 foot and 3 feet.

Estimated monthly discharge of Tule River near Portersville, Cal., for 1905.

[Drainage area, 437 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	68	38	47.4	2,914	0.108	0.124
February	173	42	75.9	4,215	.174	.181
March	822	68	230	14,140	.526	.606
April	270	173	205	12,200	.469	.523
May	455	219	313	19,250	.716	.826
June	232	75	146	8,688	.334	.373
July	68	15	32.9	2,023	.075	.086
August	15	7	9.8	603	.022	.025
September	12	7	8.2	488	.019	.021
October	18	8	12.6	775	.029	.033
November	133	15	42.4	2,523	.097	.108
December	133	82	94.2	5,792	.216	.249
The year	822	7	101	73,610	.232	3.16

MISCELLANEOUS MEASUREMENTS IN TULE RIVER DRAINAGE BASIN.

South Fork of Tule River near Success, Cal.—The following measurements were made at a point one-half mile above junction of South Fork with Main Tule River.

May 19: Width, 28 feet; area, 32 feet; mean velocity, 2.86 feet per second; discharge, 90 second-feet.

September 26, stream dry.

North Fork of Tule River near Springville, Cal.—A measurement was made September 26 at road crossing one-half mile above junction with Middle Fork of Kings River.

Water standing in pools; discharge, 00 second-feet.

Middle Fork of Tule River near Springville, Cal.—This stream is the principal tributary of Kaweah River and furnishes practically all the water of this river during low-water flow. A measurement was made September 27 one-fourth mile above clubhouse and 2 miles above the town of Springville.

Width, 33.5 feet; area, 36 square feet; mean velocity, 0.64 foot per second; discharge, 23 second-feet.

South Fork of Middle Fork of Tule River near Springville, Cal.—This stream is a tributary to Middle Fork of Kaweah River. A measurement was made September 27 at a point 100 feet above its junction with Middle Fork.

Width, 8.4 feet; area, 4.0 square feet; mean velocity, 2.20 feet per second; discharge, 8.8 second-feet.

North Fork of Middle Fork of Tule River near Springville, Cal.—This stream is tributary to Middle Fork of Kaweah River. A measurement was made September 27 100 feet above its junction with Middle Fork.

Width, 7.9 feet; area, 5.9 square feet; mean velocity, 2.19 feet per second; discharge, 12.9 second-feet.

KAWEAH RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kaweah River drains the western slope of the Sierra Nevada between the basins of Kings River on the north and Kern and Tule rivers on the south. This is an important stream, but its watershed is only about one-third that of Kings River and is much less elevated and snow covered than those of the Kings and Kern rivers. It has a number of tributaries which have their source in numerous lakes and meadows on the higher elevations. The formation is of granite and similar in every way to that in the Kings River basin. The greater part of the area of 619 square miles above the gaging station is well covered with brush and timber. In this basin is situated the Sequoia National Park, where the largest grove of big trees (*Sequoia gigantea*) of the Sierra Nevada is found. This grove is known as the "Giant Forest," and is one of the many points of interest of the Sierra Nevadas. There are two power plants on this stream owned by the Mount Whitney Power Company, which divert water from the Middle and East forks. This company has constructed several small storage reservoirs on the upper reaches of this basin. This has been done by building low dams at the outlet of some of the larger lakes. The stored water is held back for use during the low-water flow of the stream, and is of great benefit to the irrigators in the valley during the late summer months. About 6 miles below the gaging station the river leaves the foothills and flows across San Joaquin Valley in a general southwesterly direction to the old bed of Tulare Lake. After it leaves the foothills many canals divert water for the purpose of irrigating land in Tulare County, which is especially adapted to the raising of fruits.

The mean annual precipitation in the basin above the gaging station is from 20 to 40 inches, which falls in the form of snow over probably one-half the area.

KAWEAH RIVER BELOW THREE RIVERS, CAL.

This station was established April 29, 1903, by W. H. Stearns. It is located at a point three-fourths of a mile below the confluence of the North, Middle, and South forks. It is 10 miles from the Southern Pacific Railroad station at Lemon Cove, Tulare County, Cal., and one-fourth of a mile west of the wagon road from Exeter to Three Rivers.

The channel is straight for 400 feet above and below the station. The current is swift at high stages, but sluggish at low water. There are rapids about 400 feet above and 500 feet below the cable. The right bank is low and subject to overflow at high stages. The left bank is high enough to be above overflow. There are willow trees along the water's edge on both banks, and a line of willows, sycamores, and cottonwoods back from the water's edge on the left bank. The bed of the stream is composed of sand, gravel, and large bowlders. The section is probably permanent.

Discharge measurements are made from a cable and car. The initial point for soundings is a sycamore tree on the left bank of the stream, to which the cable is fastened.

The low-water gage is an inclined timber on the left bank. The high-water gage is a timber securely nailed to a willow tree on the left bank. During 1905 the gage was read by J. O. Carter. Bench marks were established as follows: (1) A point marked "B. M." with black paint on a large rock 10 feet upstream from the tree to which the cable is attached:

elevation, 13.95 feet. (2) A point on rock marked with white paint 7 feet upstream from the 75-foot mark on the cable; elevation, 15.89 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Kaweah River below Three Rivers, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 18	F. R. S. Buttemer	157	464	1.24	5.94	577
March 20	do	160	526	1.55	6.26	815
May 20	R. S. Hawley	175	647	2.70	7.25	1,746
June 14	do	170	653	2.27	7.00	1,480
July 25	do	140	306	0.44	4.83	136
September 17	C. H. Lee	29	44	0.73	4.25	32
October 24 [a]	Hawley and Lee	56	61	0.80	4.30	49

[a] Section 400 feet below cable.

Daily gage height, in feet, of Kaweah River below Three Rivers, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.9	4.9	5.4	5.8	6.8	7.05	6.05	4.65	4.3	4.3	4.2	4.6
2	4.85	5.95	5.45	5.9	6.7	7.0	6.0	4.65	4.3	4.35	4.2	4.6
3	4.8	5.4	5.5	6.0	6.55	7.0	5.9	4.65	4.2	4.3	4.25	4.55
4	4.75	5.2	5.5	6.1	6.4	7.3	5.9	4.65	4.3	4.25	4.25	4.5
5	4.7	5.65	5.5	6.2	6.3	6.8	5.8	4.6	4.3	4.3	4.25	4.6
6	4.7	5.2	5.4	6.2	6.4	7.45	5.75	4.6	4.3	4.2	4.3	4.5
7	4.7	5.15	5.45	6.3	6.55	7.05	5.75	4.6	4.3	4.25	4.3	4.6
8	4.7	5.15	5.5	6.25	6.6	6.95	5.7	4.55	4.3	4.2	4.3	4.55
9	4.7	5.15	5.5	6.25	6.5	6.8	5.7	4.55	4.3	4.3	4.3	4.55
10	4.7	5.0	5.45	6.2	6.35	7.05	5.65	4.55	4.2	4.25	4.3	4.55
11	4.7	5.1	5.55	6.15	6.3	7.15	5.6	4.55	4.25	4.2	4.3	4.5
12	4.6	5.0	[a] 5.6	6.0	6.3	7.35	5.5	4.55	4.25	4.2	4.25	4.5
13	4.7	5.1	6.9	6.0	6.35	7.25	5.4	4.55	4.25	4.2	4.25	4.5
14	4.6	5.0	5.9	6.0	6.55	7.15	5.3	4.6	4.25	4.2	4.3	4.55
15	4.6	5.0	5.8	6.1	6.9	7.15	5.25	4.6	4.25	4.2	4.25	4.55
16	4.65	5.45	6.1	6.2	7.3	7.15	5.2	4.6	4.25	4.25	4.3	4.55
17	4.7	5.35	6.0	6.2	7.4	7.1	5.2	4.45	4.2	4.25	4.3	4.5
18	4.65	5.65	5.95	6.35	7.35	7.0	5.1	4.4	4.25	[a] 4.25	4.4	4.5
19	4.7	5.3	7.0	6.3	7.4	6.95	5.1	4.4	4.2	4.25	4.3	4.55
20	4.7	5.2	6.2	6.25	7.3	6.9	5.0	4.35	4.25	4.25	4.45	4.6
21	4.95	5.2	6.1	6.15	7.45	6.8	5.0	4.4	4.25	4.2	4.5	4.6
22	4.95	5.15	5.9	6.15	7.4	6.7	5.0	4.4	4.2	4.2	4.4	4.5
23	4.8	5.1	[a] 5.9	6.15	7.3	6.6	4.95	4.4	4.2	4.2	4.4	4.5
24	4.8	5.15	5.9	6.2	7.4	6.4	4.9	4.4	4.2	4.25	4.4	4.5
25	4.75	5.2	5.9	6.35	7.5	6.30	4.9	4.4	4.2	4.3	4.4	4.6
26	4.7	5.2	6.1	6.3	7.35	6.35	4.85	4.4	4.2	4.25	4.4	4.5
27	4.7	5.1	6.0	6.35	7.1	6.0	4.85	4.4	4.2	4.25	4.55	4.5
28	4.7	5.4	5.85	6.5	6.9	6.2	4.8	4.35	4.2	4.2	4.6	4.6
29	4.7	.....	6.2	6.75	6.75	6.15	4.7	4.3	4.4	4.2	4.6	4.6
30	4.7	.....	5.9	6.85	6.85	6.15	4.7	4.3	4.45	4.25	4.6	4.6
31	4.7	.....	5.7	.....	6.95	.....	4.7	4.25	.....	4.2	.....	4.65

Station rating table for Kaweah River below Three Rivers, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.20	40	5.10	210	6.00	625	6.90	1,375
4.30	49	5.20	240	6.10	690	7.00	1,480
4.40	61	5.30	274	6.20	760	7.10	1,590
4.50	75	5.40	312	6.30	835	7.20	1,700
4.60	91	5.50	350	6.40	915	7.30	1,815
4.70	109	5.60	395	6.50	1,000	7.40	1,935
4.80	130	5.70	445	6.60	1,090	7.50	2,060
4.90	154	5.80	500	6.70	1,180		
5.00	180	5.90	560	6.80	1,275		

NOTE.—The above table is based on seven discharge measurements made during 1905. It is well defined throughout.

Estimated monthly discharge of Kaweah River below Three Rivers, Cal., for 1905.

[Drainage area, 520 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	167	91	116	7,133	0.223	0.257
February	592	154	258	14,330	.496	.51[illegible]
March	1,480	312	553	34,000	1.06	1.22
April	1,325	500	783	46,590	1.51	1.6[illegible]
May	2,060	835	1,386	85,220	2.67	3.0[illegible]
June	1,998	625	1,348	80,210	2.59	2.[illegible]
July	658	109	303	18,630	.583	.67[illegible]
August	100	44	76.6	4,710	.147	.170
September	68	40	45.2	2,690	.087	.097
October	55	40	43.4	2,669	.083	.09[illegible]
November	91	40	56.6	3,368	.109	.122
December	100	75	83.0	5,103	.160	.184
The year	2,060	40	421	304,700	.810	10.9[illegible]

MISCELLANEOUS MEASUREMENTS IN KAWEAH RIVER DRAINAGE BASIN.

Marble Fork in Sequoia National Park, Cal.—This stream is one of the principal tributaries of the Kaweah River. A measurement was made October 12 by W. B. Clapp at a point 100 yards above its junction with the Middle Fork of Kaweah River.

Width, 8.1 feet; area, 6.0 square feet, mean velocity, 0.83 foot per second; discharge, 5.0 second-feet.

Middle Fork of Kaweah River in Sequoia National Park, Cal.—This stream is one of the principal tributaries of Kaweah River. A measurement was made October 12 by W. B. Clapp at a point 100 yards above its junction with Marble Fork.

Width, 24.5 feet; area, 32.2 square feet; mean velocity, 0.51 foot per second; discharge, 16.3 second-feet.

South Fork of Kaweah River near Three Rivers, Cal.—A measurement of this stream was made October 11 by W. B. Clapp, 2 miles above junction of Grouse Creek with South Fork, about 8 miles above the town of Three Rivers.

Width, 3.5 feet; area, 1.7 square-feet; mean velocity, 2.53 feet per second; discharge, 4.3 second-feet.

East Fork of Kaweah River at power house of Mount Whitney Power Company.—Estimates of discharge of this stream were made by W. B. Clapp at the power house of Mount Whitney Power Company, 3 miles above the town of Three Rivers, Cal. The estimated discharge was calculated from discharge of nozzles at Mount Whitney Power Company's Plant.

September 28: Operating three Doble wheels. Wheel No. 1, 1½-inch nozzle; wheel No. 2, 2-inch nozzle; wheel No. 3, 2¼-inch nozzle; effective head 1,290 feet; coefficient used, 0.98; discharge, 17.4 second-feet.

October 13: Two wheels running. Wheel No. 2, 2-inch nozzle; wheel No. 3, 2¼-inch nozzle; wheel No. 1, not running; effective head, 1,290 feet; coefficient used, 0.98; discharge, 14 second-feet.

Mount Whitney Power Company's flume, 100 feet below head-gate at boundary line Sequoia National Park.—The following measurements were made during 1905 by W. B. Clapp.

September 28: Width, 6.6 feet; area, 7.9 square feet; mean velocity, 2.18 feet per second; discharge, 17.2 second-feet.

October 12: Width, 4.75 feet; area, 6.4 square feet; mean velocity, 2.95 feet per second; discharge, 18.9 second-feet.

These measurements give total flow of Middle Fork of Kaweah River, including Marble Fork.

North Fork Kaweah River near Three Rivers, Cal.—A measurement of this stream was made October 13 by W. B. Clapp at a point 5 miles above junction of South Fork with Middle Fork of Kaweah River.

Width, 12 feet; area, 3.2 square feet; mean velocity, 1.50 feet per second; discharge, 4.8 second-feet.

KINGS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kings River rises on the western slope of the Sierra Nevada and drains the country located between the San Joaquin River on the north and the Kaweah and Kern rivers on the south. The crest of the Sierra Nevada at the head of this basin reaches elevations of over 14,000 feet, and here is the most rugged portion of the range; the sharp and precipitous peaks characteristic of this part of the Sierra Nevada produce the grandest scenery to be found in the United States. The main tributaries of this stream flow through great canyons cut in the granite, with high precipitous walls. The Kings River Canyon on the South Fork and Tehipite Valley on the Middle Fork rival the famed Yosemite Valley for grandeur of scenery. There are numerous tributaries, many of which have their sources in perpetual snow banks on the higher elevation. A large number of small lakes on the higher elevations are fed by small streams from perpetual snow banks or glaciers, and in them many of the tributaries have their source. The formation is of granite, which above an elevation of 10,000 feet is bare, with scanty vegetation, being carved by the action of glaciers; below the 10,000-foot contour is a heavy covering of timber and underbrush. Extensive groves of big trees are scattered throughout this basin. On the lower elevations along the foothills the soil covering is light with a grass growth used for pasturage. Fully 80 per cent of the drainage area is now included in the boundaries of the Sierra Forest Reserve which is patrolled for the prevention of fires and illegal herding. Below the gaging station, which is located at the point where the river leaves the foothills, canals divert the water for use in the valley lands of Fresno, Kings, and Tulare counties, where the climate and soil are especially adapted to the raising of grapes, fruits, etc., and the soil is under a high state of cultivation. During the period of flood discharge some water passes these canals and finds its way across Kings River delta in the natural channel to the old bed of Tulare Lake, which is now but an intermittent lake due largely to the diversion of water for irrigation purposes from the streams which drain into it.

There is a drainage area of 1,742 square miles above the Red Mountain gaging station. The mean annual precipitation for this area varies from about 30 to 60 inches, which over a greater portion of the basin falls in the form of snow. The greater discharge of this stream is in the spring months when the snow is melting.

KINGS RIVER NEAR SANGER, CAL.

This station was established September 3, 1895, by J. B. Lippincott. It is located 15 miles east of Sanger, Cal., near the mouth of the canyon, and is above all diversions.

The channel is nearly straight for 300 feet above and below the station, and has a width of 180 feet at ordinary stages. The bed of the stream is composed of gravel and small bowlders and changes but little. The right bank is high and not subject to overflow. The left bank is subject to overflow during extreme high water. The current is swift.

Discharge measurements are made by means of a cable and car. The initial point for soundings is an eyebolt embedded in concrete on the right bank of river. An automatic river stage register was installed April 18, 1903. There is also an inclined wooden gage near by from which readings were formerly taken and which is now used in checking the self-recording gage. Mr. O. G. Williams reads the gage once each day and also examines the automatic register to see that it is in proper working order. The mean daily gage height is determined from the register sheets by the use of planimeter. The bench mark is a cross marked on a rock which is 24 feet upstream from the self-recording register; elevation, 18.00 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Kings River near Sanger, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 21	F. R. S. Buttemer	217	883	2.73	6.91	2,406
May 22	R. S. Hawley	317	1,827	4.95	10.10	9,046
June 15	do	314	1,808	4.67	10.10	8,446
July 24	do	160	584	1.69	5.42	986
August 19	do	145	390	.97	4.33	382
September 16	C. H. Lee	126	317	.63	3.82	199
October 21	Hawley and Lee	113	128	1.53	3.79	196

Mean daily gage height, in feet, of Kings River near Sanger, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.65	5.0	5.5	6.25	8.9	9.0	7.8	4.95	4.1	4.05	3.8	4.10
2	4.55	5.65	5.7	6.5	8.35	9.05	7.6	4.85	4.05	4.0	3.8	4.05
3	4.45	5.6	5.85	6.6	8.05	9.15	7.5	4.8	4.0	4.0	3.8	4.0
4	4.45	5.45	5.95	6.7	7.7	8.85	7.4	4.8	4.0	3.9	3.8	4.1
5	4.4	5.7	5.9	6.9	7.55	8.7	7.3	4.7	4.0	3.85	3.8	4.15
6	4.4	5.65	5.9	7.05	7.65	9.05	7.25	4.65	4.0	3.85	3.8	4.1
7	[a] 4.4	5.4	5.9	7.2	7.75	9.35	7.25	4.6	4.0	3.8	3.8	4.1
8	[a] 4.4	5.3	5.95	7.2	7.9	9.3	7.2	4.6	3.95	3.8	3.8	4.1
9	4.4	5.25	5.95	7.25	7.7	9.1	7.2	4.6	3.95	3.8	3.8	4.05
10	4.35	5.15	5.9	7.25	7.4	9.4	7.2	4.65	3.9	3.8	3.8	4.0
11	4.4	5.05	5.9	7.0	7.4	9.8	7.15	4.6	3.9	3.75	[a] 3.8	4.0
12	4.3	5.0	5.95	6.75	7.4	10.25	7.0	4.55	3.9	3.75	3.8	4.0
13	4.2	4.85	7.15	6.6	7.45	10.3	6.7	4.55	3.9	3.75	3.8	4.0
14	4.35	4.85	7.35	6.6	7.95	10.2	6.4	4.5	3.9	3.7	3.8	4.0
15	[a] 4.35	4.85	6.65	6.9	8.8	10.0	6.2	4.45	3.9	3.7	3.8	4.0
16	4.35	5.0	6.55	7.05	9.6	9.9	6.0	4.45	3.85	3.7	3.8	4.0
17	4.4	5.4	6.75	7.0	10.25	9.85	5.85	4.4	3.8	3.7	3.8	4.0
18	4.4	5.25	6.75	7.3	10.15	9.6	5.75	4.4	3.8	3.75	3.8	4.0
19	4.35	5.2	7.0	7.2	10.15	9.4	5.65	4.35	3.8	3.75	3.9	4.0
20	4.45	5.15	7.2	6.9	10.05	9.4	5.6	4.3	3.8	3.8	3.95	4.05
21	4.7	5.1	6.9	6.85	10.15	9.45	5.55	4.3	3.8	3.8	4.0	4.1
22	4.8	5.1	6.55	6.8	10.15	9.4	5.55	4.3	3.75	3.8	3.9	4.0
23	4.6	5.15	6.4	6.8	9.95	8.95	5.5	4.3	3.75	3.8	3.9	3.9
24	4.6	5.2	6.5	7.1	9.95	8.45	5.5	4.25	3.75	3.8	3.8	3.9
25	4.55	5.25	6.6	7.5	10.15	8.2	5.5	4.2	3.75	3.7	3.8	[a] 3.9
26	4.5	5.3	6.8	7.5	10.15	8.25	5.5	4.2	3.7	3.7	3.85	3.9
27	4.45	5.3	6.7	7.75	9.4	8.05	5.45	4.2	3.7	3.7	3.9	4.0
28	4.45	5.35	6.4	8.2	8.85	7.95	5.4	4.15	3.7	3.7	4.1	4.0
29	4.45	.....	6.55	8.75	8.5	8.0	5.25	4.1	3.75	3.75	4.0	4.0
30	4.45	.....	6.4	9.05	8.65	8.0	5.15	4.1	3.95	3.75	[a] 4.0	4.0
31	4.5	.....	6.25	.....	8.9	.....	5.05	4.1	.....	3.75	.....	3.9

[a] Gage height estimated.

Station rating table for Kings River near Sanger, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	150	5.00	740	6.30	1,730	8.00	3,850
3.80	175	5.10	805	6.40	1,820	8.20	4,190
3.90	205	5.20	870	6.50	1,920	8.40	4,570
4.00	240	5.30	940	6.60	2,020	8.60	4,980
4.10	280	5.40	1,010	6.70	2,120	8.80	5,425
4.20	325	5.50	1,085	6.80	2,230	9.00	5,890
4.30	370	5.60	1,160	6.90	2,340	9.20	6,380
4.40	420	5.70	1,235	7.00	2,460	9.40	6,915
4.50	470	5.80	1,310	7.20	2,705	9.60	7,495
4.60	520	5.90	1,390	7.40	2,965	9.80	8,115
4.70	570	6.00	1,470	7.60	3,240	10.00	8,770
4.80	625	6.10	1,550	7.80	3,535	10.20	9,450
4.90	680	6.20	1,640				

NOTE.—The above table is based on discharge measurements made during 1895-1905. It is well defined throughout.

Estimated monthly discharge of Kings River near Sanger, Cal., for 1905.

[Drainage area, 1,742 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	625	325	447	27,480	0.257	0.296
February	1,235	652	899	49,930	.516	.537
March	2,900	1,085	1,844	113,400	1.06	1.22
April	6,010	1,685	2,731	162,500	1.57	1.75
May	9,622	2,965	5,887	361,600	3.38	3.90
June	9,795	3,770	6,448	383,700	3.70	4.13
July	3,535	772	1,859	114,300	1.07	1.23
August	710	280	448	27,550	.257	.296
September	280	150	198	11,780	.114	.127
October	260	150	174	10,700	.100	.115
November	280	175	191	11,360	.110	.123
December	302	205	246	15,130	.141	.163
The year	9,795	150	1,781	1,289,000	1.02	13.89

MISCELLANEOUS MEASUREMENTS IN KINGS RIVER DRAINAGE BASIN.

North Fork of Kings River.—This stream enters Kings River from the north about 20 miles above point where the main Kings River leaves the foothills and enters the San Joaquin Valley. A measurement was made 500 feet above its junction with main river and about 50 feet above lower trail crossing on August 22, 1905, by R. S. Hawley.

Width, 16 feet; area, 21 square feet; mean velocity, 1.86 feet per second; discharge, 39 second-feet.

Converse Creek.—This stream enters the Kings River 7 miles below the junction of Middle and South forks. A measurement was made 200 feet above its mouth on August 23, 1905, by R. S. Hawley.

Width, 4 feet; area, 1.6 square feet; mean velocity, 0.77 foot per second; discharge, 1.2 second-feet.

Ten Mile Creek.—This creek enters Kings River one-half mile below junction of Middle and South forks. A measurement was made on August 23, 1905, 100 feet above its mouth by R. S. Hawley.

Width, 2 feet; area, 1.6 square feet; mean velocity, 0.69 foot per second; discharge, 1.1 second-feet.

Boulder Creek.—This stream enters the South Fork of Kings River 5 miles above the junction of the Middle and South forks. A measurement was made on August 25, 1905, 2 miles above its mouth and 100 feet above lower trail crossing by R. S. Hawley.

Width, 6 feet; area, 2.8 square feet; mean velocity, 1.14 feet per second; discharge, 3.2 second-feet.

Lightning Creek.—This stream enters the South Fork of Kings River from the south about 10 miles above the junction of the Middle and South forks. An estimate was made of the discharge about 1 mile above its mouth at the trail crossing on August 25, 1905, by R. S. Hawley.

Discharge, 0.60 second-foot.

Lewis Creek.—This stream enters the South Fork of Kings River from the north in Kings River Canyon 2 miles below old Cedar Grove Hotel. A measurement was made August 26, 1905, 500 feet above its mouth by R. S. Hawley.

Width, 3 feet; area, 2.7 square feet; mean velocity, 1.00 foot per second; discharge, 2.7 second-feet.

South Fork of Kings River.—This stream is the principal tributary to Kings River. A measurement was made in the lower Kings River Canyon one-fourth mile above the mouth of Lewis Creek on August 26, 1905, by R. S. Hawley.

Width, 52 feet; area, 51 square feet; mean velocity, 2.73 feet per second; discharge, 139 second-feet.

South Fork of Kings River.—A measurement was made 700 feet above the mouth of Bubbs Creek on August 26, 1905, by R. S. Hawley.

Width, 35 feet; area, 36 square feet; mean velocity, 1.36 feet per second; discharge, 49 second-feet.

South Fork of Kings River.—A measurement was made August 26, 1905, one-fourth mile below the mouth of Bubbs Creek by R. S. Hawley.

Width, 65 feet; area, 68 square feet; mean velocity, 1.46 feet per second; discharge, 99 second-feet.

Bubbs Creek.—This is the principal tributary of South Fork of Kings River and joins it at the head of Kings River Canyon. From the measurements made on South Fork of Kings River above and below the junction of Bubbs Creek on August 26, 1905, by R. S. Hawley, the discharge of Bubbs Creek at the mouth was estimated to be 50 second-feet. On account of roughness of stream bed and high velocities in the creek it was impossible to make discharge measurement. (See measurement of South Fork of Kings River above and below mouth of Bubbs Creek.)

Copper Creek.—This stream enters the South Fork of Kings River from the north between North Dome and Buck Peak. A measurement was made on August 26, 1905, one-fourth mile above its mouth by R. S. Hawley.

Width, 4 feet; area, 1.0 square foot; mean velocity, 0.82 foot per second; discharge, 0.82 second-foot.

Roaring River.—This stream enters South Fork of Kings River from the south, 5 miles below the junction of South Fork and Bubbs Creek. A measurement was made August 26, 1905, 500 feet above its mouth by R. S. Hawley.

Width, 14 feet; area, 11 square feet; mean velocity, 0.87 foot per second; discharge, 9.6 second-feet.

Sheep Creek.—This stream enters the South Fork of Kings River from the south one-fourth mile below Cedar Grove Hotel. An estimate was made of the discharge at the mouth August 26, 1905, by R. S. Hawley.

Discharge, 1.8 second-feet.

Hotel Creek.—This stream enters South Fork of Kings River from the north at Cedar Grove Hotel. An estimate was made of the discharge at its mouth on August 26, 1905, by R. S. Hawley.

Discharge, 0.20 second-foot.

Granite Creek.—This stream enters South Fork of Kings River from the north between North Mountain and North Dome. An estimate was made of the discharge at the mouth August 26, 1905, by R. S. Hawley.

Discharge, 0.50 second-foot.

Horseshoe Creek.—This stream enters Middle Fork of Kings River from the south at Simpson Meadow. An estimate was made of the discharge at its mouth on August 28, 1905, by R. S. Hawley.

Discharge, 2.4 second-feet.

Middle Fork of Kings River.—This is one of the principal tributaries of Kings River and drains the high Sierra Nevadas in the northeastern portion of its watershed. A measurement was made on August 28, 1905, 50 feet above the mouth of Horseshoe Creek, at the lower end of Simpson Meadow, by R. S. Hawley.

Width, 41 feet; area, 65 square feet; mean velocity, 1.83 feet per second; discharge, 119 second-feet.

Goddard Creek.—This stream is the principal tributary of Middle Fork of Kings River, entering it from the north. A measurement was made August 28, 1905, one-fourth mile above its mouth at Simpson Meadow by R. S. Hawley.

Width, 26 feet; area, 29 square feet; mean velocity, 1.93 feet per second; discharge, 56 second-feet.

Dougherty Creek.—This stream enters Middle Fork of Kings River from the south about 1 mile below Simpson Meadow. A measurement was made August 29, 1905, 300 feet above its mouth by R. S. Hawley.

Width, 4 feet; area 4.4 square feet; mean velocity, 0.86 foot per second; discharge, 3.8 second-feet.

Slide Creek.—This is a small stream entering Middle Fork of Kings River from the south 3 miles below Simpson Meadow. An estimate of its discharge was made 300 feet above its mouth August 29, 1905, by R. S. Hawley.

Discharge, 0.50 second-foot.

Crown Creek.—This stream enters Middle Fork of Kings River in Tehipite Valley one-half mile southwest of Tehipite Dome. An estimate of its discharge was made on August 29, 1905, 500 feet above its mouth, above the trail crossing, by R. S. Hawley.

Discharge, 8.0 second-feet.

Blue Canyon Creek.—This stream enters Middle Fork of Kings River 2 miles above Tehipite Dome. An estimate was made of the discharge August 29, 1905, 200 feet above its mouth by R. S. Hawley.

Discharge, 1.4 second-feet.

Rancheria Creek.—This stream enters North Fork of Kings River about 4 miles below Cliff Camp. A measurement was made on August 31, 1905, about 4 miles above its mouth and just below its junction with North Fork of Rancheria Creek by R. S. Hawley.

Width, 8 feet; area, 7.2 square feet; mean velocity, 0.78 foot per second; discharge, 5.6 second-feet.

North Fork of Rancheria Creek.—This stream joins Rancheria Creek about 4 miles above its mouth. A measurement was made August 31, 1905, 100 feet above its junction with Rancheria Creek, by R. S. Hawley.

Width, 2 feet; area, 1.2 square feet; mean velocity, 2.00 feet per second; discharge, 2.4 second-feet.

North Fork of Kings River.—A measurement was made on this stream on August 31, 1905, about one-half mile above Cliff Camp and about 15 miles above its mouth, by R. S. Hawley.

Width, 8.0 feet; area, 12.8 square feet; mean velocity, 0.73 foot per second; discharge, 9.4 second-feet.

Bear Creek.—This stream is tributary to North Fork of Kings River through Dinkey Creek. An estimate was made of the discharge of this stream on August 31, 1905, about 2 miles above its junction with Dinkey Creek at trail crossing, by R. S. Hawley.

Discharge, 0.70 second-foot.

Laurel Creek.—This stream is tributary to North Fork of Kings River through Bear Creek and Dinkey Creek. An estimate was made of the discharge on August 31, 1905, about one-fourth mile above junction with Bear Creek, by R. S. Hawley.

Discharge, 0.40 second-foot.

Dinkey Creek.—This stream is a tributary of North Fork of Kings River from the west. A measurement was made about 1½ miles above the mouth of Bear Creek at Dinkey Meadows on September 1, 1905, by R. S. Hawley.

Width, 6 feet; area, 4 square feet; mean velocity, 0.70 foot per second; discharge, 2.8 second-feet.

MERCED RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Merced River drains that portion of the western slope of the Sierra Nevada located between the Tuolumne River on the north and the San Joaquin River on the south. Its drainage area is much less than that of the Tuolumne River. It has numerous tributaries, several of which are of considerable size.

The topography of the country in this basin is similar to that of the Tuolumne River being rough and broken in the upper reaches. In this basin is situated the famous Yosemite

Valley with its precipitous walls and domes and great waterfalls, which occur on the main stream and its tributaries, which discharge into the valley over precipitous cliffs rising 2,000 to 3,000 feet above the floor of the valley. The formation is of granite which on the upper reaches of the basin above Yosemite Valley is bare, rising in precipitous peaks and domes, and is smoothly marked by glacial action. The middle reaches of the basin are well timbered. The Mariposa grove of big trees is situated in the basin of the South Fork. The timber growth extends well down on the lower elevations to the foothills where the covering is of brush and grass, used extensively for pasturage. Numerous lakes are scattered over the upper portion of the basin. The mean annual precipitation varies from 25 inches in the foothills to 60 inches on the higher elevations, where it falls in the form of snow, which melts in the spring months, except on the extreme higher mountain peaks, where it often remains during the entire year. After leaving the foothills at Merced Falls, where the gaging station is located, canals divert the water for irrigation on lands along the river bottom and in San Joaquin Valley. The surplus water during flood discharge enters San Joaquin River.

MERCED RIVER IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 11, 1904, by A. E. Chandler and N. W. Currie. It is located at the wagon bridge, near the Sentinel Hotel.

The channel is straight for a distance of 150 feet above and 50 feet below station. The current is sluggish. The right bank is low and subject to overflow. The left bank is high and above high water. The bed of the stream is composed of coarse gravel and sand, with small bowlders, and is not subject to much change.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is stream face of abutment on right bank.

The gage is a vertical timber, securely fastened to a masonry abutment on west bank. The bench mark is the heads of two large nails driven into the stream face of the bridge-seat timber on the left abutment; elevation, 14.64 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Merced River in Yosemite Valley, California, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 6	W. B. Clapp	93	593	2.40	6.15	1,421
June 8	do	93	626	2.58	6.45	1,617
June 11	N. W. Currie	93	730	3.14	6.95	2,289
June 12	do	93	782	3.52	7.52	2,751
June 20	do	93	730	3.07	6.92	2,240
June 25	do	93	594	2.28	6.00	1,354
June 28	do	90	568	2.15	5.70	1,221
July 4	do	90	518	1.90	5.40	984
July 13	do	90	448	1.44	4.80	647
July 17	do	90	396	.92	4.20	365
July 31	do	92	362	.52	3.78	190
August 25	do	92	308	.30	3.40	91
October 24	do	20	10.5	1.46	3.10	[a]15.3

[a] Wading 400 feet below bridge.

Daily gage height, in feet, of Merced River in Yosemite Valley, California, for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6.2	5.7	3.7	3.3	3.3	17	.....	7.1	4.2	3.5	3.1	[a] 3.15
2	.....	6.2	5.5	3.7	3.3	[a] 3.3	18	.....	6.9	4.15	3.5	3.1	[a] 3.15
3	.....	6.1	5.3	3.7	3.3	3.25	19	.....	6.8	4.2	3.45	3.15	[a] 3.15
4	.....	5.95	5.4	3.7	3.25	[a] 3.25	20	.....	6.9	4.2	3.45	3.2	[a] 3.1
5	.....	5.8	5.35	3.65	3.2	[a] 3.25	21	.....	7.1	4.2	3.45	3.2	3.1
6	.....	6.2	5.35	3.6	3.2	[a] 3.25	22	.....	7.0	4.2	3.45	3.2	[a] 3.1
7	.....	6.5	5.3	3.6	3.2	3.25	23	6.8	6.5	4.2	3.45	3.3	[a] 3.1
8	.....	6.4	5.25	3.6	3.2	[a] 3.25	24	6.8	6.5	4.2	3.4	3.3	3.1
9	.....	6.2	5.5	3.7	3.2	[a] 3.2	25	7.1	6.0	4.1	3.4	3.3	.....
10	.....	6.55	5.5	3.7	3.2	3.2	26	7.1	6.0	4.1	3.35	3.3	.....
11	.....	7.0	5.3	3.7	3.2	[a] 3.2	27	6.3	5.8	4.1	3.3	3.3	.....
12	.....	7.5	5.1	3.6	3.15	3.2	28	[a] 6.0	5.7	4.0	3.3	3.4	.....
13	.....	7.45	4.8	3.6	3.1	[a] 3.2	29	5.7	5.95	3.9	3.3	3.4	.....
14	.....	7.35	4.5	3.5	3.1	3.15	30	6.1	5.8	3.8	3.3	3.35	.....
15	.....	7.3	4.35	3.5	3.1	3.15	31	6.1	.....	3.8	3.3	.....	.....
16	.....	7.4	4.3	3.5	3.1	[a] 3.15							

[a] Gage height estimated.

Station rating table for Merced River in Yosemite Valley, California, from July 11, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	15	4.10	326	5.10	815	6.20	1,505
3.20	38	4.20	368	5.20	870	6.40	1,645
3.30	63	4.30	412	5.30	925	6.60	1,795
3.40	90	4.40	457	5.40	985	6.80	1,950
3.50	118	4.50	504	5.50	1,045	7.00	2,110
3.60	147	4.60	552	5.60	1,105	7.20	2,275
3.70	178	4.70	602	5.70	1,170	7.40	2,445
3.80	212	4.80	653	5.80	1,235		
3.90	248	4.90	706	5.90	1,300		
4.00	286	5.00	760	6.00	1,365		

NOTE.—The above table is based on 12 discharge measurements made during 1904-5. It is well defined between gage heights 3.1 feet and 6.5 feet.

Estimated monthly discharge of Merced River in Yosemite Valley, California, for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
July 11-31	602	286	463	19,280
August	552	112	248	15,250
September 1-24	412	63	131	6,236
1905.				
May 23-31	2,190	1,170	1,696	30,280
June	2,530	1,170	1,771	105,400
July	1,170	212	610	37,510
August	178	63	123	7,563
September	90	15	44.4	2,642
October 1-24	63	15	35.3	1,680
The period				185,100

MERCED RIVER ABOVE MERCED FALLS, CAL.

The measurement of this stream was undertaken in response to numerous requests from mining and irrigation interests. The midsummer flow of the stream is less than the combined capacity of the irrigation and power canals taking water in the vicinity of Snelling. The station was established April 6, 1901, by H. H. Henderson. It is located 1 mile above Merced Falls.

Both banks are high and rocky and are not subject to overflow. The bed of the stream is composed of gravel and is subject to some change.

Discharge measurements are made from a cable and car.

The gage is a timber bolted to iron stakes driven in the bed of the stream on the left bank. During 1905 the gage was read by Charles Siegfeldt. The bench mark is a three-fourths inch round iron bolt set 10 inches in the slate rock on the right bank of the river; elevation, 69.20 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Merced River above Merced Falls, California, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 16	F. R. S. Buttemer	179	447	2.84	10.19	1,269
April 7	O. W. Peterson	184	597	3.79	10.75	2,263
May 24	R. S. Hawley	265	862	4.94	11.91	4,261
June 17	do	272	797	4.56	11.65	3,632
July 21	do	141	282	1.74	9.04	490
September 14	C. H. Lee	106	128	.43	7.82	56
October 19	Hawley and Lee	104	128	.37	7.80	48
October 19	do	44	38	1.34	7.80	51
December 7	Hawley and Eaton	65	57	1.58	8.00	90

Daily gage height, in feet, of Merced River above Merced Falls, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.2	9.2	9.5	10.15	11.55	11.45	10.4	8.6	8.0	7.85	7.85	8.1
2	8.95	13.45	9.6	10.2	11.2	11.35	10.25	8.5	7.95	7.8	7.8	8.1
3	8.85	10.75	9.7	10.3	10.95	11.35	10.15	8.5	7.95	7.9	7.85	8.0
4	8.8	10.45	9.8	10.4	10.8	11.2	10.05	8.45	8.0	7.8	7.8	7.95
5	8.7	10.8	9.8	10.5	10.7	11.05	10.05	8.4	8.05	7.9	7.8	8.0
6	8.7	10.35	9.75	10.6	10.6	11.2	9.95	8.4	8.0	7.9	7.8	8.0
7	8.7	9.85	9.8	10.7	10.7	11.45	9.95	8.35	7.9	7.9	7.8	8.0
8	8.7	9.65	9.85	10.7	11.05	11.45	9.9	8.35	7.9	7.9	7.8	8.0
9	8.7	9.5	9.85	10.7	10.85	11.35	9.95	8.4	7.9	7.9	7.8	8.0
10	8.7	9.4	9.85	10.75	10.65	11.35	10.0	8.3	7.9	7.9	7.85	8.0
11	8.7	9.3	9.85	10.6	10.6	11.6	9.9	8.35	7.9	7.9	7.85	8.0
12	8.65	9.25	9.8	10.4	10.5	11.95	9.8	8.4	7.9	7.8	7.9	7.9
13	8.6	9.1	10.95	10.3	10.6	11.85	9.7	8.4	7.9	7.8	7.8	7.9
14	8.6	9.1	10.6	10.25	10.85	11.75	9.55	8.35	7.85	7.85	7.8	7.9
15	8.6	9.1	10.25	10.4	11.35	11.7	9.35	8.3	7.8	7.85	7.8	7.95
16	8.7	9.1	10.15	10.6	12.05	11.7	9.25	8.25	7.85	7.8	7.85	7.95
17	8.7	9.3	11.3	10.5	12.7	11.6	9.1	8.2	7.85	7.8	7.85	8.0
18	8.6	9.3	10.7	10.55	12.5	11.45	9.1	8.2	7.85	7.8	7.85	8.1
19	8.7	9.3	13.55	10.8	12.25	11.4	9.05	8.15	7.85	7.8	7.85	8.1
20	8.7	9.35	11.75	10.55	12.35	11.3	9.0	8.1	7.8	7.8	7.9	8.05
21	8.9	9.35	10.9	10.4	12.25	11.3	9.0	8.1	7.8	7.8	7.9	8.1
22	9.05	9.3	10.55	10.35	11.95	11.3	9.0	8.1	7.8	7.85	7.9	8.05
23	8.9	9.25	10.3	10.35	11.8	11.05	9.0	8.1	7.75	7.9	7.9	8.05
24	8.85	9.25	10.3	10.55	11.9	10.85	9.0	8.1	7.8	7.85	7.9	8.0
25	8.85	9.3	10.25	10.8	12.05	10.65	9.0	8.1	7.7	7.85	7.9	8.0
26	8.8	9.4	10.3	10.85	12.05	10.6	8.9	8.1	7.7	7.85	7.9	8.0
27	8.75	9.4	10.45	11.0	11.65	10.55	8.9	8.1	7.8	7.85	8.0	8.0
28	8.7	9.4	10.2	11.4	11.4	10.45	8.85	8.1	7.8	7.85	7.95	8.05
29	8.7	.....	10.4	11.75	11.15	10.5	8.8	8.0	7.8	7.85	8.25	8.2
30	8.7	.....	10.35	11.8	11.2	10.5	8.75	8.0	7.8	7.8	8.15	8.2
31	8.8	.....	10.2	.....	11.35	.....	8.65	8.0	.....	7.8	.....	8.2

Station rating table for Merced River above Merced Falls, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.70	35	9.00	465	10.30	1,570	11.60	3,570
7.80	50	9.10	520	10.40	1,690	11.70	3,755
7.90	70	9.20	580	10.50	1,820	11.80	3,945
8.00	90	9.30	645	10.60	1,955	11.90	4,140
8.10	115	9.40	715	10.70	2,095	12.00	4,340
8.20	140	9.50	790	10.80	2,240	12.20	4,755
8.30	170	9.60	870	10.90	2,390	12.40	5,200
8.40	200	9.70	955	11.00	2,545	12.60	5,665
8.50	235	9.80	1,045	11.10	2,705	12.80	6,140
8.60	275	9.90	1,140	11.20	2,870	13.00	6,630
8.70	315	10.00	1,240	11.30	3,040		
8.80	360	10.10	1,345	11.40	3,215		
8.90	410	10.20	1,455	11.50	3,390		

NOTE.—The above table is based on 9 discharge measurements made during 1905. It is well defined between gage heights 7.8 feet and 12 feet.

Estimated monthly discharge of Merced River above Merced Falls, Cal., for 1905.

[Drainage area, 1,090 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	580	275	345	21,210	0.317	0.366
February	7,760	520	1,105	61,370	1.01	1.05
March	8,020	790	1,774	109,100	1.63	1.88
April	3,945	1,400	2,050	122,000	1.88	2.10
May	5,900	1,820	3,316	203,900	3.04	3.50
June	4,240	1,755	2,980	177,300	2.73	3.05
July	1,690	295	804	49,440	.738	.851
August	275	90	158	9,715	.145	.167
September	102	35	62.8	3,737	.058	.065
October	70	50	59.0	3,628	.054	.062
November	155	50	66.4	3,951	.061	.068
December	140	70	97.5	5,995	.089	.103
The year	8,020	35	1,068	771,300	.979	13.26

YOSEMITE CREEK IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 9, 1904, by A. E. Chandler and N. W. Currie. It is located at the wagon bridge, about one-half mile from Yosemite, Cal.

The channel is straight for 50 feet above and 100 feet below station. Both banks are above high water. The bed of the stream is composed of small granite fragments and is permanent.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is the stream face of the abutment on the right bank.

The gage is a vertical timber securely fastened to an alder tree on the right bank 50 feet above bridge. The bench mark is the heads of two nails driven in the alder tree, to which the gage is fastened. Elevation, 9.40 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Yosemite Creek in Yosemite Valley, California, in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 7	W. B. Clapp	39	106	2.19	0.05	232
June 13	N. W. Currie	37	122	2.39	6.55	290
June 19	do	40	100	2.8	5.78	208
June 24	do	35	82	1.72	5.40	141
June 27	do	35	76	1.54	5.15	117
July 4	do	33	57	1.16	4.75	66
July 14	do	31	42	.71	4.30	30
July 23	do	29	35	.42	4.10	14.7
August 1	do	28	29	.08	3.90	2.3

Daily gage height, in feet, of Yosemite Creek in Yosemite Valley, California, for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	6.3	5.0	3.9	3.7	3.7	17	.....	6.0	4.2	3.79	3.7	[a] 3.65
2	.....	6.4	4.9	3.7	3.7	[a] 3.7	18	.....	5.9	4.2	3.79	[a] 3.7	[a] 3.65
3	.....	6.3	4.8	3.85	3.7	3.65	19	.....	5.78	4.2	3.75	[a] 3.7	[a] 3.65
4	.....	5.95	4.75	3.85	3.7	[a] 3.65	20	.....	5.75	4.2	3.75	[a] 3.7	[a] 3.65
5	.....	5.8	4.75	3.85	3.7	[a] 3.65	21	.....	5.9	4.18	3.75	[a] 3.7	3.65
6	.....	5.9	4.75	3.8	3.7	[a] 3.65	22	.....	5.7	4.15	3.75	3.65	[a] 3.65
7	.....	6.2	4.7	3.8	3.7	3.65	23	6.7	5.4	4.1	3.75	[a] 3.65	[a] 3.65
8	.....	6.1	4.7	3.7	3.7	[a] 3.65	24	6.7	5.4	4.1	3.75	3.65	3.65
9	.....	6.0	4.75	3.8	3.7	[a] 3.65	25	6.8	5.25	4.0	3.75	[a] 3.65	.....
10	.....	6.5	4.7	3.8	3.7	[a] 3.65	26	6.8	5.3	4.0	3.75	[a] 3.65	.....
11	.....	6.3	4.6	3.8	3.7	[a] 3.65	27	6.3	5.15	4.0	3.72	[a] 3.65	.....
12	.....	6.4	4.5	3.8	[a] 3.7	[a] 3.65	28	6.2	5.0	3.95	3.7	3.7	.....
13	.....	6.55	4.4	3.78	3.7	[a] 3.65	29	6.0	5.2	3.95	3.7	[a] 3.7	.....
14	.....	6.35	4.3	3.8	3.7	3.65	30	6.3	5.0	3.9	3.7	3.7	.....
15	.....	6.35	4.25	3.8	3.7	[a] 3.65	31	6.3	.....	3.9	3.7	.....	.....
16	.....	6.35	4.25	3.79	3.7	[a] 3.65							

[a] Estimated.

Station rating table for Yosemite Creek in Yosemite Valley, California, from July 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.70	2	4.60	50	5.50	150	6.40	280
3.80	3	4.70	59	5.60	163	6.50	296
3.90	5	4.80	69	5.70	177	6.60	312
4.00	8	4.90	79	5.80	191	6.70	328
4.10	14	5.00	90	5.90	205	6.80	344
4.20	20	5.10	101	6.00	220	6.90	360
4.30	27	5.20	113	6.10	235	7.00	377
4.40	34	5.30	125	6.20	250		
4.50	42	5.40	137	6.30	265		

NOTE.—The above table is based on 11 discharge measurements made during 1904-5. It is well defined.

Estimated monthly discharge of Yosemite Creek in Yosemite Valley, California, for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
July 11 to 31	59	8	32.2	1,341
August	59	3	9.9	609
September 1 to 24	50	2.5	4.7	224
1905.				
May 23 to 31	344	220	290	5,177
June	304	90	206	12,260
July	90	5	34.3	2,109
August	5	2	2.8	172
September	2	1.5	1.9	113
October 1 to 24	2	1.5	1.5	71
The period				19,900

TENAYA CREEK IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 11, 1904, by A. E. Chandler and N. W. Currie. It is located by the wagon bridge, about 2 miles from Yosemite, Cal.

The channel is straight for 200 feet above and below the station. Both banks are above high water. The bed of the stream is composed of small granite fragments and is not subject to change.

Discharge measurements are made from the bridge. The initial point for soundings is the stream face of the abutment on the right bank.

The gage is a vertical timber securely fastened to the bridge stringer on upper side of bridge, 9 feet from left abutment. The bench mark is formed by the heads of two nails in the top of the bridge stringer near the gage; elevation, 12.70 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Tenaya Creek in Yosemite Valley, California, in 1905.

Date.	Hydrographer	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
June 7	W. B. Clapp	45	119	3.36	5.95	400
June 14	N. W. Currie	45	125	3.42	6.00	428
June 19	do	45	110	3.03	5.65	333
June 24	do	45	90	2.46	5.18	221
June 28	do	45	72	2.01	4.80	145
July 5	do	42	51	1.59	4.40	81
July 12	do	41	37	1.19	4.10	44
July 24	do	34	16.8	.84	3.60	14.1
October 1[a]	do				3.35	3

[a] Estimated.

Daily gage height, in feet, of Tenaya Creek in Yosemite Valley, California, for 1905.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	5.9	4.7	3.5	3.35	3.35	17	5.8	3.85	3.38	3.35	[a] 3.35
2	5.9	4.6	3.5	3.35	[a] 3.35	18	5.75	3.8	3.38	[a] 3.35	[a] 3.35
3	5.9	4.5	3.5	3.35	[a] 3.35	19	5.65	3.75	3.38	[a] 3.35	[a] 3.35
4	5.7	4.4	3.45	3.35	[a] 3.35	20	5.55	3.7	3.38	[a] 3.35	[a] 3.35
5	5.6	4.4	3.45	3.35	[a] 3.35	21	5.55	3.7	3.38	[a] 3.35	3.35
6	5.7	4.35	3.4	3.35	[a] 3.35	22	5.5	3.65	3.38	[a] 3.35	.....
7	6.0	4.3	3.4	3.35	3.35	23	5.3	3.6	3.38	3.35	.....
8	5.8	4.25	3.4	3.35	[a] 3.35	24	5.18	3.6	3.38	3.35	.....
9	5.75	4.2	3.4	3.35	[a] 3.35	25	5.1	3.6	3.38	[a] 3.35	.....
10	6.0	4.1	3.4	3.35	3.35	26	5.0	3.55	3.38	[a] 3.35	.....
11	6.01	4.1	3.38	3.35	[a] 3.35	27	4.9	3.55	3.38	[a] 3.35	.....
12	6.0	4.1	3.38	3.35	[a] 3.35	28	4.83	3.55	3.38	[a] 3.35	.....
13	6.15	4.0	3.38	3.35	[a] 3.35	29	4.8	3.5	3.35	[a] 3.35	.....
14	5.98	3.95	3.38	3.35	3.35	30	4.7	3.5	3.35	3.35	.....
15	5.95	3.9	3.38	3.35	3.35	31	.....	3.5	3.35	.....	.....
16	5.9	3.85	3.38	3.35	[a] 3.35						

[a] Gage heights estimated.

Station rating table for Tenaya Creek in Yosemite Valley, California, from July 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.40	4.5	4.20	54	5.00	184	5.80	368
3.50	8	4.30	66	5.10	204	5.90	395
3.60	12	4.40	80	5.20	225	6.00	422
3.70	17	4.50	95	5.30	247	6.10	450
3.80	22	4.60	111	5.40	270	6.20	480
3.90	28	4.70	128	5.50	293	6.30	512
4.00	35	4.80	146	5.60	317		
4.10	44	4.90	165	5.70	342		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904–5. It is well defined between gage heights 3.3 feet and 6 feet.

Estimated monthly discharge of Tenaya Creek in Yosemite Valley, California, for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
July 11–31	80	17	38.3	1,595
August	28	4.5	12.3	756
September 1–24	80	3.9	8.6	409
1905.				
May 23–31	512	368	425	7,587
June	465	128	323	19,220
July	128	8	38.8	2,386
August	8	3	4.4	270
September	3	3	3.0	179
October 1–21	3	3	3.0	125
The period	.....	.....	.....	29,770

MISCELLANEOUS MEASUREMENTS IN MERCED RIVER DRAINAGE BASIN.

Bridal Veil Creek, Yosemite Valley, California.—This stream is a tributary of the Merced River. An estimate was made of the discharge at a point 500 feet above its junction with Merced River and about 1,000 feet below Bridal Veil Falls on June 7, 1905, by W. B. Clapp. It was impossible to make a measurement on account of the rough bed and heavy grade of the stream.

Estimated discharge, 100 second-feet.

Cascade Creek, Yosemite Valley, California.—This stream is a tributary of the Merced River. An estimate was made of the discharge at a point 500 feet below Cascade Falls near mouth of creek on June 6, 1905, by W. B. Clapp.

Estimated discharge, 150 second-feet.

Ribbon Falls Creek, Yosemite Valley, California.—This stream is tributary to Merced River in Yosemite Valley. A measurement was made where the creek crosses the road on the west side of the valley on June 7 by W. B. Clapp.

The stream was flowing in several shallow channels.

Total width, 20.5 feet; area, 9.0 square feet; mean velocity, 1.89 feet per second; discharge, 17.0 second-feet.

TUOLUMNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Tuolumne River rises on the western slope of the Sierra Nevada and drains the country located between Stanislaus River on the north and Merced River on the south. It has numerous tributaries, several of which produce a heavy discharge. The country throughout this basin is rough and rugged, especially along the main river, which cuts through solid granite, with high precipitous cliffs on either side. Along this stream is found some of the grandest scenery of the Sierra Nevada. This stream drains the northern portion of the Yosemite National Park, where is located the Grand Canyon of the Tuolumne and the Hetch Hetchy Valley, which is pronounced by many to exceed the famed Yosemite Valley in grandeur and beauty. The formation is of granite, which on the higher elevations is bare and glaciated, often rising thousands of feet in vertical cliffs and domes. Along the middle reaches of this basin there is good soil covering, with a heavy timber growth of pine, fir, cedar, and other kindred trees. On the lower reaches the covering is a heavy growth of brush, which diminishes in the foothills where the stream enters the San Joaquin Valley. This portion of the basin has a light soil covering, with grass growth, which is used for pasturage. There are several glacial lakes throughout the upper reaches of this basin, many of the larger of which offer exceptional opportunities for the construction of storage reservoirs. There are also many reservoir sites on the main river. The stream has a heavy fall, and the opportunities for power development are numerous. Several diversions are made above the gaging station, which is located at Lagrange, where the stream breaks from the foothills. The precipitation on the upper half of this basin falls in the form of snow, a greater portion of which disappears in the spring months, but on the higher elevations remains until late in the summer. The mean annual rainfall varies from about 30 inches on the lower foothills to about 60 inches on the higher elevations.

TUOLUMNE RIVER AT LAGRANGE, CAL.

This station was established August 29, 1895, by J. B. Lippincott. It is located at the wagon bridge, in the town of Lagrange. It is below the high dam, where the diversions are made by the Turlock and Modesto canals, and also below the head of the canal of the Lagrange Ditch and Hydraulic Mining Company, which diverts water from the left bank of the river above the dam.

The channel is straight for 400 feet above and 600 feet below the station. It is broken by two iron piers and has a width at ordinary stages of 300 feet. During the season of

low flow all the water is taken out by the Turlock and Modesto canals above the station. The record of flow of these canals is kept. The bed of the stream is composed of gravel and is fairly permanent. The current is swift at high stages and very sluggish during low water. The discharge has gradually increased each year for the same gage heights. Both banks are high and not subject to overflow.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is a mark on the railing of the bridge 100 feet north from the center of first pier on right bank of the river.

The gage is a vertical timber fastened to the right abutment of the bridge. During 1905 the gage was read by R. A. Trumbly. Bench marks were established as follows: (1) Top of a rock marked with white paint, situated on the left bank below the bridge and opposite the 573 foot mark of the cross section; elevation, 19.10 feet. (2) The top of rock marked with white paint, situated 75 feet downstream from bench mark No. 1; elevation, 16.89 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Tuolumne River at Lagrange, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 15	F. R. S. Buttemer	325	1,426	1.79	6.10	2,548
April 6	O. W. Patterson	332	1,591	2.40	6.60	3,817
May 24	R. S. Hawley	344	2,068	3.79	7.90	7,846
June 16	do	344	2,068	3.66	7.90	7,574
June 17	do	344	1,906	3.28	7.45	6,249
September 13	C. H. Lee	30	20	.45	3.30	9.2
October 18	Lee and Hawley	38	36	1.47	3.68	53

Daily gage height, in feet, of Tuolumne River at Lagrange, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.7	5.75	5.7	5.9	7.3	7.0	6.05	3.2	3.1	3.7	3.65	4.05
2	5.1	8.1	5.85	6.05	6.7	7.0	6.0	3.2	3.1	3.85	3.65	4.05
3	5.0	6.3	5.9	5.9	6.3	6.9	5.8	3.2	3.1	3.8	3.65	4.0
4	4.8	6.0	5.9	5.9	6.35	6.85	5.45	3.2	3.1	3.7	3.65	4.0
5	4.8	6.35	5.9	5.95	6.15	6.75	5.5	3.2	3.1	3.6	3.65	4.0
6	4.8	6.1	5.9	6.3	6.15	6.7	5.5	3.2	3.1	3.6	3.65	4.0
7	4.75	5.6	5.9	6.65	6.35	6.85	5.35	3.2	3.1	3.6	3.65	4.0
8	4.75	5.5	5.9	6.6	6.5	7.1	5.4	3.2	3.1	3.6	3.65	4.0
9	4.75	5.4	5.85	6.45	6.2	7.6	5.15	3.2	3.1	3.5	3.65	4.0
10	4.75	5.4	5.8	6.5	6.1	7.9	5.0	3.2	3.1	3.5	3.65	4.0
11	4.8	5.2	5.85	6.4	6.0	8.0	4.85	3.2	3.1	3.5	3.65	3.9
12	4.8	5.1	5.8	6.05	6.0	8.05	4.7	3.2	3.4	3.5	3.65	3.9
13	4.8	5.1	6.95	5.8	5.9	8.0	4.55	3.2	3.3	3.5	3.65	4.0
14	4.8	5.0	6.55	5.75	6.1	7.85	4.5	3.2	3.3	3.5	3.7	3.95
15	4.8	5.0	6.1	5.9	6.8	7.85	4.75	3.2	3.2	3.5	3.7	3.95
16	4.8	4.9	6.1	5.95	7.7	7.8	4.7	3.2	3.2	3.5	3.7	3.95
17	4.8	5.1	7.3	5.9	8.7	7.6	3.65	3.2	3.2	3.5	3.7	4.0
18	4.8	5.1	7.0	5.95	8.25	7.45	3.4	3.1	3.2	3.6	3.7	4.0
19	4.8	5.1	9.3	5.9	8.0	7.3	3.3	3.1	3.2	3.65	3.7	4.0
20	4.85	5.85	7.6	5.9	8.0	7.25	3.2	3.1	3.2	3.65	3.75	4.05
21	5.0	5.65	6.85	5.9	8.25	7.35	3.2	3.1	3.2	3.7	3.8	4.15
22	5.1	5.4	6.6	5.95	7.9	6.9	3.2	3.1	3.2	3.7	3.75	4.1
23	5.15	5.4	6.5	6.6	7.6	6.25	3.2	3.1	3.2	3.7	3.75	4.05
24	5.2	5.4	6.3	7.1	7.8	6.15	3.2	3.1	3.2	3.7	3.75	4.05
25	5.1	5.55	6.1	7.1	8.0	6.15	3.2	3.1	3.2	3.7	3.8	4.05
26	5.0	5.8	6.1	7.2	7.85	6.1	3.2	3.1	3.2	3.7	3.8	4.0
27	4.85	5.7	6.2	7.2	7.65	6.05	3.2	3.1	3.3	3.7	3.85	4.0
28	4.8	5.8	6.1	7.35	7.35	6.05	3.2	3.1	3.25	3.7	4.0	4.1
29	4.8	.....	6.45	7.4	6.7	6.20	3.2	3.1	3.4	3.65	4.0	4.15
30	4.9	.....	6.25	7.7	6.85	6.05	3.2	3.1	3.5	3.65	4.05	4.15
31	4.9	.....	6.1	.....	6.9	.....	3.2	3.1	.....	3.65	.....	4.2

Station rating table for Tuolumne River at Lagrange, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.10	1	4.50	340	5.90	2,200	7.60	6,700
3.20	5	4.60	410	6.00	2,400	7.80	7,360
3.30	10	4.70	490	6.10	2,610	8.00	8,060
3.40	20	4.80	580	6.20	2,830	8.20	8,780
3.50	30	4.90	680	6.30	3,060	8.40	9,500
3.60	40	5.00	790	6.40	3,300	8.60	10,260
3.70	55	5.10	910	6.50	3,550	8.80	11,050
3.80	70	5.20	1,030	6.60	3,800	9.00	11,850
3.90	90	5.30	1,170	6.70	4,060	9.20	12,660
4.00	120	5.40	1,310	6.80	4,320	9.40	13,480
4.10	150	5.50	1,470	6.90	4,600	9.60	14,320
4.20	190	5.60	1,630	7.00	4,880	9.80	15,160
4.30	230	5.70	1,810	7.20	5,470	10.00	16,000
4.40	280	5.80	2,000	7.40	6,070		

Estimated monthly discharge of Tuolumne River at Lagrange, Cal., for 1905.

[Drainage area, 1,501 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,810	535	745	45,810	0.496	0.572
February	8,420	745	1,926	107,000	1.28	1.33
March	13,070	1,871	3,487	214,400	2.32	2.68
April	7,770	2,696	4,016	239,000	2.68	2.99
May	11,360	2,866	5,927	364,400	3.95	4.55
June	9,075	3,258	5,969	355,200	3.98	4.44
July	3,403	427	1,344	82,640	.895	1.03
August	345	103	212	13,040	.141	.163
September	131	[a] 8	78.1	4,647	.052	.058
October	80	30	45.5	2,798	.030	.035
November	135	48	62.2	3,701	.041	.046
December	190	90	129	7,932	.086	.099
The year	13,070	8	1,995	1,441,000	1.33	17.90

[a] The minimum of 8 feet in September was caused by closing head-gate of Turlock Canal and holding water back in reservoir until dam overflowed.

NOTE.—The above discharge includes that of Turlock and Modesto canals.

MODESTO CANAL AT LAGRANGE, CAL.

The Modesto canal is the property of the Modesto irrigation district. The water is diverted from the right side of the Tuolumne River at the Lagrange dam. This canal was designed to carry 660 second-feet and to irrigate land in the vicinity of Modesto, Stanislaus County, Cal. The principal part of the construction work was done on this canal prior to 1892, but on account of litigation the canal was not completed until April, 1903.

On April 26, 1903, a gage rod was set in and a rating made of Indian Hill flume, near Lagrange, Cal. From May 10 to June 3 and from June 10 to June 25, inclusive, boards were placed in the flumes to back the water up and keep the flumes saturated. During this time gage heights were obtained by taking the depth of the water in the canal below Indian Hill flume.

On July 12, 1904, the station was moved to the flume near the intake. This was done so that more gage readings and explanations of their fluctuations could be obtained by having J. L. Montgomery, the regulator of the gates at the intake, act as gage observer. This flume is 11.85 feet in width.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

Discharge measurements of Modesto canal at Lagrange, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 6	O. W. Peterson	11.8	40	7.28	3.40	291
May 24	R. S. Hawley	11.8	37	6.68	3.15	247
June 17	do	11.8	45	7.18	3.85	323
July 21	do	12	35	6.34	2.95	222

Daily gage height, in feet, of Modesto canal at Lagrange, Cal., for 1905.

Day.	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.0	2.8	[a] 1.2	2.6	3.0	3.5	4.0	1.7	1.0
2	0	[b] 0	1.2	2.9	3.0	3.5	4.0	1.8	.95
3	0	[a] 1.3	1.2	3.1	3.0	3.5	[b] 0	1.8	.95
4	0	2.0	1.2	3.2	3.0	3.5	[a] 2.5	1.6	.95
5	0	2.1	1.2	3.3	3.0	3.5	3.5	1.65	.95
6	0	2.0	1.25	3.3	3.0	3.5	4.0	1.65	.8
7	0	1.95	1.25	3.3	3.0	3.6	4.0	1.4	.85
8	0	2.45	1.25	3.2	3.0	3.6	4.0	1.55	.8
9	0	2.8	1.25	3.2	3.0	3.6	4.5	1.55	.8
10	0	3.0	1.25	3.1	3.0	3.6	4.5	1.4	.8
11	0	3.0	1.25	3.2	3.0	2.5	4.5	1.5	.4
12	0	3.1	.85	3.2	3.0	3.5	4.0	1.4	.....
13	0	3.2	.5	3.2	3.0	2.75	4.0	1.4	.....
14	0	3.3	.7	3.1	3.0	3.7	4.0	1.4	.....
15	0	3.3	.7	3.0	3.0	3.7	4.0	1.3	.....
16	[a] 1.0	3.3	.7	3.0	3.0	3.7	4.0	1.3	.....
17	.9	3.3	.8	3.0	3.0	3.7	4.0	1.3	.....
18	.9	3.3	.8	3.0	3.0	3.75	4.0	1.3	.....
19	.9	3.3	[b] 0	3.0	3.0	3.75	3.0	1.25	.....
20	.9	3.0	0	3.0	3.2	3.75	3.0	1.0	.....
21	1.05	2.7	0	3.0	3.2	3.8	2.9	1.1	.....
22	1.05	3.3	[a] 2.0	3.0	[b] 0	3.9	2.9	1.15	.....
23	1.05	3.0	2.1	3.0	0	3.9	2.5	1.15	.....
24	1.05	2.75	2.5	3.0	[a] 3.15	4.0	2.5	1.15	.....
25	1.05	2.75	2.5	3.0	3.3	1.75	2.75	1.15	.....
26	1.6	[b] 0	2.8	3.0	3.35	1.55	2.7	1.15	.....
27	2.0	0	[b] 0	3.0	3.35	4.0	2.55	1.1	.....
28	2.05	0	0	3.0	3.5	4.0	2.4	.9	.....
29	2.05	.....	0	3.0	3.5	4.0	2.55	.9	.....
30	2.35	.....	[a] 1.5	3.0	3.5	4.0	2.1	.9	.....
31	2.7	.....	2.0	.....	3.5	.....	2.1	1.0	.....

[a] Water turned in. [b] Water turned out.

NOTE.—Canal dry September 12 to December 31.

Station rating table for Modesto canal at Lagrange, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.10	2	1.10	53	2.10	140	3.20	252
20	4	1.20	61	2.20	150	3.40	274
30	7	1.30	69	2.30	160	3.60	296
40	11	1.40	77	2.40	170	3.80	318
50	16	1.50	85	2.50	180	4.00	340
60	21	1.60	94	2.60	190	4.20	364
70	26	1.70	103	2.70	200	4.40	388
80	32	1.80	112	2.80	210		
90	38	1.90	121	2.90	220		
1.00	45	2.00	130	3.00	230		

NOTE.—The above table is based on discharge measurements made during 1904–1905. It is well defined between gage heights 0.5 foot and 4 feet. Monthly estimates are included with those of Tuolumne River, p. 210.

TURLOCK CANAL AT LAGRANGE, CAL.

The Turlock canal, the property of the Turlock irrigation district, takes water from the left bank of the Tuolumne River at the Lagrange dam. This canal was designed to carry 1,500 second-feet and to irrigate a large area of fertile land in the vicinity of Turlock and Ceres, Stanislaus County, Cal.

During 1898 water was first turned into the canal in small quantities and used for puddling the banks. A record of the gage height has been kept since July, 1899. Meter measurements are made when the gaging station on the Tuolumne River at Lagrange is visited, and Morgan flume, or flume No. 2, has been rated. It is 13.75 feet in width.

In the spring of 1905 a station was established in flume No. 1 and used for some time, but it did not give satisfactory results during high stages of the canal. Gage readings were discontinued on this flume and resumed on the Morgan flume. The record since May 22, 1905, is on the Morgan flume. The observer is J. J. R. Johnson, the canal tender.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

Discharge measurements of Turlock canal at Lagrange, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 8	O. W. Peterson	19.5	24	1.96	1.22	47
April 8	do	19.5	40	3.20	2.05	128
April 8	do	19.5	55	3.82	2.80	210
April 8	do	19.5	81	4.60	4.15	375
May 24	R. S. Hawley	13.8	72	7.13	5.30	514
June 17	do	13.8	76	7.58	5.55	576
July 21	do	13.8	66	6.55	4.65	432
September 14	C. H. Lee	13.6	28	3.07	2.04	86

NOTE.—Measurements on April 8 were made on little flume near head of canal, others made at Morgan flume.

Daily gage height, in feet, of Turlock canal at Lagrange, Cal., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	4.15	5.3	5.4	5.55	3.1	2.0
2	.....	4.1	5.3	5.4	5.6	3.2	2.0
3	.....	4.1	5.4	5.4	5.6	3.15	1.9
4	.....	4.15	5.2	5.4	5.6	2.9	1.9
5	.....	4.2	5.2	5.4	5.6	2.95	1.9
6	.....	0	5.2	5.4	5.6	2.95	1.8
7	.....	0	4.1	5.4	5.6	2.65	1.8
8	.....	3.2	4.6	5.4	5.6	2.65	1.65
9	.....	3.0	4.7	5.4	5.6	2.65	1.65
10	.....	1.5	4.7	5.45	5.6	2.65	1.65
11	.....	4.6	4.7	5.4	5.6	2.65	1.65
12	.....	4.7	4.7	5.5	5.6	2.6	1.65
13	.....	4.8	4.7	5.5	5.6	2.7	1.8
14	.....	5.5	4.75	5.5	5.6	2.4	2.5
15	.....	5.5	4.85	5.5	3.6	2.4	2.1
16	.....	5.5	4.9	5.5	5.6	2.4	2.1
17	.....	5.5	5.0	5.5	5.2	2.4	1.8
18	.....	5.5	5.0	5.55	5.4	2.4	1.8
19	.....	5.2	5.0	5.5	5.0	2.4	1.7
20	.....	5.2	0	5.5	5.0	2.0	1.75
21	.....	5.3	0	5.5	4.8	2.15	1.75
22	1.6	5.2	5.3	5.5	4.8	2.2	1.75
23	2.1	5.25	5.25	5.5	4.2	2.2	1.75
24	2.1	5.25	5.25	5.5	4.55	2.2	1.75
25	3.0	5.25	5.3	5.55	4.55	2.2	1.75
26	3.4	5.2	5.4	5.55	4.5	2.2	1.75
27	4.1	5.3	5.4	5.55	4.25	2.2	.....
28	4.1	5.4	5.4	5.55	4.0	1.8	.....
29	2.1	5.3	5.4	5.6	4.1	1.8	.....
30	4.1	5.3	5.4	5.55	3.6	1.8	.....
31	4.0	.....	5.4	.....	3.6	2.0	.....

NOTE.—Canal dry January 1 to March 21 and September 26 to December 31.

Station rating table for Turlock canal at Lagrange, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.30	1	1.50	40	2.70	166	3.90	324
40	2	1.60	47	2.80	178	4.00	338
50	3	1.70	55	2.90	190	4.20	366
60	4	1.80	64	3.00	202	4.40	394
70	5	1.90	74	3.10	215	4.60	422
80	7	2.00	85	3.20	228	4.80	450
90	10	2.10	96	3.30	241	5.00	478
1.00	14	2.20	107	3.40	254	5.20	506
1.10	18	2.30	118	3.50	268	5.40	535
1.20	23	2.40	130	3.60	282	5.60	565
1.30	28	2.50	142	3.70	296		
1.40	34	2.60	154	3.80	310		

NOTE.—The above table is based on discharge measurements made during 1904–5. It is well defined between gage heights 2 feet and 5.5 feet. Monthly estimates are included with those of Tuolumne River, p. 210.

MISCELLANEOUS MEASUREMENTS IN TUOLUMNE RIVER DRAINAGE BASIN.

Clavey River.—This stream is tributary to Tuolumne River from the north and enters it about 10 miles above the mouth of the North Fork. A measurement was made on September 15, 1905, just above the bridge for the new trail from Tuolumne to Lake Eleanor, by H. A. Campbell.

Width, 10 feet; area, 14.3 square feet; mean velocity, 0.87 foot per second; discharge, 12.5 second-feet.

Cherry River.—This stream is tributary to the Tuolumne River from the north and enters it about 15 miles below Hetch Hetchy Valley. A measurement was made one-third of a mile above the mouth of Eleanor Creek on September 16, 1905, by H. A. Campbell.

Width, 2 feet; area, 1.4 square feet; mean velocity, 1.00 foot per second; discharge, 1.4 second-feet.

Cherry River at Cherry Valley, Cal.—A measurement was made at the old gaging station in the lower end of Cherry Valley on main trail from Tuolumne to Lake Eleanor on September 17, 1905, by H. A. Campbell.

Width, 2.2 feet; area, 1.6 square feet; mean velocity, 0.58 foot per second; discharge, 0.92 second-foot.

Eleanor Creek.—A measurement was made on September 18, 1905, 1 mile below outlet from Lake Eleanor and about 3 miles above its junction with Cherry Creek, by H. A. Campbell.

Width, 2.0 feet; area, 0.50 square foot; mean velocity, 0.60 foot per second; discharge, 0.30 second-foot.

Tuolumne River at Hetch Hetchy, Cal.—A measurement was made on September 18, 1905, at the head of Hetch Hetchy Valley, one-half mile above mouth of Rancheria Creek, by H. A. Campbell.

Width, 14 feet; area, 12 square feet; mean velocity, 1.83 feet per second; discharge, 22 second-feet.

Rancheria Creek.—This stream enters Tuolumne River from the north in Hetch Hetchy Valley. A measurement was made on September 19, 1905, 100 yards above trail crossing, about 1½ miles above its junction with Tuolumne River, by H. A. Campbell.

Width, 4 feet; area, 3.3 square feet; mean velocity, 0.94 foot per second; discharge, 3.1 second-feet.

Tiltill Creek.—This stream enters the Tuolumne River from the north in Hetch Hetchy Valley. A measurement was made on September 19, 1905, at lower end of Tiltill Valley about 2 miles above its junction with Tuolumne River, by H. A. Campbell.

Width, 0.9 foot; area, 0.18 square foot; mean velocity, 0.67 foot per second; discharge, 0.12 second-foot.

Falls Creek.—This stream enters Tuolumne River from the north in Hetch Hetchy Valley. A measurement was made on September 19, 1905, at the outlet of Lake Vernon, by H. A. Campbell.

Width, 4.4 feet; area, 1.6 square feet; mean velocity, 0.75 foot per second; discharge, 1.2 second-feet.

Tuolumne River at Hetch Hetchy Valley, Cal.—A measurement was made on September 21, 1905, at the lower end of Hetch Hetchy Valley about one-half mile below trail to Lake Eleanor, by H. A. Campbell.

Width, 18.5 feet; area, 13.5 square feet; mean velocity, 1.78 feet per second; discharge, 24 second-feet.

Middle Fork of Tuolumne River.—A measurement was made on this stream on September 21, 1905, about 100 yards downstream from the bridge on the road from Sequoia to Hog Ranch by H. A. Campbell.

Width, 2 feet; area, 0.60 square foot; mean velocity, 0.93 foot per second; discharge, 0.56 second-foot.

South Fork of Tuolumne River.—A measurement was made on this stream on September 22, 1905, about 75 yards upstream from the bridge on the Big Oak Flat and Yosemite Toll Road, near Harden ranch, by H. A. Campbell.

Width, 11.2 feet; area, 10.6 square feet; mean velocity, 0.42 foot per second; discharge, 4.5 second-feet.

Mining ditch near Lagrange, Cal.—This ditch diverts water from the Tuolumne River several miles above the town of Lagrange, Cal. A measurement was made April 6 at a point on the hill above the Lagrange dam.

Width, 6 feet; area, 4.3 square feet; mean velocity, 1.58 feet per second; discharge, 6.8 second-feet.

STANISLAUS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Stanislaus River drains a portion of the western slope of the Sierra Nevada and heads well back on the crest, at elevations of from 10,000 to 12,000 feet. It drains the country between the basins of the Mokelumne River on the north and the Tuolumne River on the south, and flows in a general southwesterly direction, entering the San Joaquin River 23 miles above Stockton. It has numerous tributaries in the upper reaches of the basin, which have their source in numerous small glacial lakes. The topography is rough and broken with high mountain peaks. The formation is of granite, which is bare and destitute of timber growth above an elevation of 8,000 feet, except where small glacial lakes and moraines occur. In the middle reaches of the basin there is good soil covering and a heavy growth of timber. In this basin is situated the Calaveras grove of big trees (*Sequoia gigantea*), for which the Sierra Nevada are famous. This is the most northerly grove of these trees, groves of which extend as far south as the Kern River basin. The mean annual rainfall for the basin is about 50 inches. The precipitation falls chiefly in the form of snow on the higher elevations, remaining well into the summer months. Mining operations have been carried on extensively in this basin, and many canals have been taken out of the river, all of which discharge their water into the river again. The canal of the Stanislaus Water Company diverts water 3 miles above Knights Ferry, which is used to irrigate land between Knights Ferry and Stockton. A gaging station is maintained on this canal to determine its discharge.

STANISLAUS RIVER AT KNIGHTS FERRY, CAL.

A station was first established on this river on May 3, 1895, at the railroad bridge one-half mile north of the town of Oakdale. On July 30, 1898, a cable was placed 1,000 feet below the railroad bridge. This station was used until February 16, 1901.

The station at Knights Ferry was established May 19, 1903, by W. H. Stearns. It is located 200 feet from the post-office at Knights Ferry.

There is an island 800 feet above the gaging station, and a dam on each channel at the head of the island. The Stanislaus Milling and Power Company's power house is on the right bank of the river below one of these dams and about 1,000 feet above the gaging station. The channel is straight for 500 feet above and below the cable. At ordinary and high stages the stream has a fall of 0.47 foot in the 500 feet above the cable and of 0.68 foot in the 500 feet below. Both banks are composed of cemented gravel and are high. The left bank is not subject to overflow. In extreme floods the right bank has been known to be overflowed, flooding the yards and houses next to the river. The bed is of gravel and is subject to some change from the addition of material which is washed down from the island above.

Discharge measurements at high and medium stages are made from a car suspended from a cable. Low-water measurements are made by wading 300 feet above the cable. The initial point for soundings is the eyebolt to which the cable is fastened on the right bank.

Ordinary and low-water stages were read on an iron pipe driven into the bed of the stream. For high stages the gage was a plank nailed to a post on the right bank of the river. A new gage rod has been placed near the cable on the right bank and gage readings are now made on this rod. It consists of an inclined rod fastened securely to posts set in the ground. This portion of the rod is used for the lower stages. For high water there is a vertical section similar to the above at the north cable support. During 1905 the gage was read once each day by E. J. Coop. Bench marks were established as follows: (1) A spike in a locust tree 50 feet northeast of right cable support; elevation, 19.20 feet. (2) A rock under the spike at the foot of the above locust tree; elevation, 18.74 feet. Elevations refer to the datum of the new gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

Discharge measurements of Stanislaus River at Knights Ferry, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 14	F. R. S. Buttemer	197	751	3.36	9.15	2,525
April 6	O. W. Peterson	198	769	3.49	9.25	2,687
April 16	R. S. Hawley	194	771	3.27	9.30	2,518
May 23	do	217	944	4.30	10.05	4,062
July 20	do	148	363	1.17	7.00	425
September 12	Lee and Keeler	40	51	1.68	6.19	86
September 22	R. W. Keeler	40	49	1.57	6.11	77
September 29	do	40	49	1.63	6.17	80
October 6	do	40	49	1.69	6.14	83
October 13	do	40	48	1.77	6.19	85
October 16	Lee and Hawley	40	47	1.85	6.21	87
December 21	R. W. Keeler	120	268	.53	6.41	142

Daily gage height, in feet, of Stanislaus River at Knights Ferry, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.4	7.75	8.25	8.55	9.8	9.45	7.95	6.4	6.15	6.1	6.1	6.45
2	7.3	10.15	8.4	8.7	9.5	9.35	7.8	6.4	6.15	6.1	6.1	6.3
3	7.25	8.4	8.45	8.85	9.35	9.25	7.7	6.4	6.15	6.15	6.1	6.25
4	7.15	8.05	8.55	8.95	9.1	9.0	7.65	6.4	6.15	6.15	6.1	6.3
5	7.1	8.85	8.5	9.1	9.0	8.8	7.6	6.35	5.7	6.15	6.1	6.3
6	7.05	8.45	8.5	9.25	8.85	8.85	7.45	6.3	5.7	6.1	6.1	6.3
7	7.0	8.1	8.5	9.4	9.4	9.2	7.45	6.3	6.2	6.1	6.1	6.3
8	7.0	7.85	8.45	9.4	9.35	9.2	7.45	6.25	6.2	6.1	6.1	6.3
9	7.15	7.8	8.4	9.4	9.1	9.1	7.45	6.25	6.15	6.1	6.1	6.3
10	7.2	7.7	8.4	9.45	8.95	9.15	7.4	6.25	6.1	6.1	6.15	6.3
11	7.1	7.65	8.45	9.15	8.8	9.4	7.3	6.25	6.1	6.1	6.2	6.3
12	7.05	7.6	8.4	8.95	8.75	9.65	7.3	6.25	6.15	6.1	6.2	6.3
13	7.0	7.45	9.1	8.9	8.75	9.65	7.2	6.2	6.15	6.1	6.2	6.3
14	7.0	7.4	9.0	8.95	9.05	9.5	7.1	6.2	6.15	6.1	6.2	6.3
15	7.1	7.4	8.55	9.1	9.5	9.3	7.0	6.25	6.2	6.15	6.2	6.3
16	7.4	7.4	9.1	9.25	10.15	9.4	6.9	6.2	6.2	6.2	6.2	6.3
17	7.3	7.7	10.35	9.05	11.2	9.25	6.85	6.2	6.2	6.15	6.2	6.25
18	7.3	7.8	9.6	9.2	10.55	9.2	6.85	6.2	6.2	6.15	6.2	6.25
19	7.25	7.8	11.5	9.25	10.4	9.05	6.75	6.2	6.2	6.15	6.2	6.3
20	7.3	8.6	10.0	8.9	10.25	8.95	6.85	6.25	6.15	6.15	6.2	6.4
21	7.7	8.45	9.35	8.8	10.35	8.95	6.75	6.25	6.15	6.15	6.25	6.4
22	7.5	8.2	9.25	8.75	10.05	8.9	6.7	6.25	6.1	6.15	6.3	6.3
23	7.7	8.1	8.85	8.9	9.9	8.7	6.75	6.25	6.15	6.15	6.3	6.25
24	7.65	8.1	8.8	9.05	9.85	8.45	6.85	6.25	6.15	6.15	6.25	6.2
25	7.55	8.15	8.85	9.45	9.95	8.2	6.75	6.25	6.15	6.1	6.2	6.2
26	7.5	8.3	8.9	9.65	10.0	8.25	6.7	6.25	6.15	6.1	6.2	6.25
27	7.35	8.3	9.2	10.0	9.55	8.1	6.65	6.25	6.15	6.1	6.3	6.3
28	7.3	8.25	8.75	10.1	9.2	8.0	6.55	6.25	6.15	6.1	6.3	6.3
29	7.25	.....	8.95	10.35	9.1	8.0	6.55	6.15	6.15	6.1	6.4	6.4
30	7.05	.....	8.75	10.45	9.3	8.0	6.5	6.25	6.15	6.1	6.5	6.45
31	6.75	.....	8.65	.....	9.35	.....	6.45	6.2	6.15	6.1	.....	6.4

Station rating table for Stanislaus River at Knights Ferry, Cal., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	60	7.30	630	8.60	1,840	9.90	3,550
6.10	70	7.40	710	8.70	1,960	10.00	3,700
6.20	80	7.50	800	8.80	2,080	10.20	4,040
6.30	95	7.60	890	8.90	2,200	10.40	4,400
6.40	125	7.70	980	9.00	2,320	10.60	4,800
6.50	160	7.80	1,070	9.10	2,440	10.80	5,230
6.60	200	7.90	1,160	9.20	2,560	11.00	5,730
6.70	245	8.00	1,250	9.30	2,680	11.20	6,330
6.80	295	8.10	1,340	9.40	2,800	11.40	6,990
6.90	350	8.20	1,440	9.50	2,950	11.60	7,700
7.00	410	8.30	1,540	9.60	3,100		
7.10	480	8.40	1,640	9.70	3,250		
7.20	550	8.50	1,740	9.80	3,400		

Estimated monthly discharge of Stanislaus River at Knights Ferry, Cal., for 1905.

[Drainage area, 935 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Second-feet per square mile.	Depth in inches.
January	1,015	294	642	39,480	0.687	0.79
February	4,002	731	1,326	73,640	1.42	1.4[illegible]
March	7,394	1,533	2,395	147,300	2.56	2.95
April	4,625	1,905	2,774	165,100	2.97	3.3[illegible]
May	6,445	2,124	3,247	99,650	3.47	4.00
June	3,296	1,351	2,392	142,300	2.56	2.[illegible]
July	1,309	225	613	37,690	.656	.75
August	211	97	150	9,223	.160	.184
September	137	90	103	6,129	.110	.12
October	138	85	97	5,964	.104	.13
November	189	77	91	5,415	.097	.10
December	185	96	131	8,055	.140	1.61
The year	7,394	77	1,163	739,900	1.24	18.29

NOTE.—The discharge of Stanislaus Water Company's ditch and Schell ditch is included above. Mean daily flow of Schell ditch is estimated at 7 second-feet.

STANISLAUS WATER COMPANY'S DITCH AT KNIGHTS FERRY, CAL.

This station was established June 11, 1904, by S. G. Bennett. The station is located below the point where Schell ditch diverts its water, about 1 mile below the Stanislaus Milling and Power Company's power house and 200 feet below the place where it passes under Schell ditch flume. The water diverted by this ditch is used for irrigation in the vicinity of Oakdale, Cal.

A meter measurement on Schell ditch 200 feet below its intake gave a discharge of about 7 second-feet, which is said to be its usual constant flow. In computing the estimated monthly discharge of Stanislaus River a mean daily discharge of 7 second-feet has been used as the capacity of Schell ditch.

The gage is fastened to the upstream side of a small bridge. During 1905 the gage was read once each day by E. J. Coop.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Stanislaus Water Company's ditch at Knights Ferry, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 14	F. R. S. Buttemer	13.2	22	2.14	2.58	47
May 23	R. S. Hawley	8.7	27	4.24	3.65	114
June 16	do	8.5	24	4.00	3.45	96
July 20	do	9	21	3.67	3.00	77
September 12	C. H. Lee	11	6.1	.85	1.12	5.2
September 12	do	8.7	5.5	1.58	1.50	8.7
September 12	do	9.4	13.1	2.52	2.18	33
September 12	do	9.4	12.6	2.38	2.08	30
October 17	R. S. Hawley	7.5	2.1	.38	.80	.8

Daily gage height, in feet, of Stanislaus Water Company's canal at Knights Ferry, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.3	2.3	3.55	3.7	3.7	3.4	3.1	1.95	2.8	0.0	2.1
2	2.4	2.4	2.6	3.7	3.6	3.6	3.45	3.0	2.0	2.65	1.5	2.15
3	2.5	2.05	.0	3.5	3.5	3.6	3.35	3.05	2.1	2.4	1.8	2.2
4	2.5	1.9	.0	3.65	3.5	3.7	3.45	3.05	2.05	2.3	1.5	1.95
5	2.5	.0	.0	3.55	3.55	3.6	3.35	3.1	3.45	2.2	1.5	2.2
6	2.3	2.1	2.3	3.65	3.6	3.6	3.4	3.1	3.3	2.1	1.2	2.1
7	2.5	.0	2.5	3.7	3.5	2.55	3.3	3.1	2.0	2.15	.0	2.0
8	2.5	.0	2.25	3.65	3.3	3.45	3.4	3.05	2.0	2.2	.0	2.05
9	2.45	.0	2.55	3.6	3.2	3.6	3.4	3.0	2.1	2.05	.0	2.1
10	2.45	.0	2.5	3.6	3.3	3.7	3.45	2.95	2.2	1.70	.0	2.1
11	2.25	.0	3.4	3.55	3.4	3.65	3.3	2.95	2.15	1.75	.0	1.8
12	2.45	1.45	3.0	3.6	3.45	3.65	3.3	2.95	2.0	1.85	.0	1.95
13	2.05	.0	2.6	3.5	3.4	3.6	3.3	3.1	2.1	1.4	.0	2.0
14	2.0	1.8	2.45	3.65	3.45	3.6	3.25	2.8	1.6	1.2	.0	1.85
15	2.2	1.7	2.45	3.65	3.7	3.5	3.15	2.85	1.6	1.0	.0	1.65
16	2.15	1.9	2.6	3.7	3.7	3.5	3.35	2.9	1.5	1.4	.0	1.8
17	2.35	2.3	2.6	3.65	3.55	3.5	3.1	2.7	1.4	1.3	.0	2.2
18	2.1	2.2	2.5	3.55	3.6	3.5	3.1	2.5	1.4	1.2	.0	2.1
19	2.1	2.4	2.45	3.6	3.7	3.5	3.0	2.45	1.1	1.3	.0	1.95
20	2.3	2.0	2.8	3.55	3.65	3.45	3.2	2.3	1.35	1.4	.0	2.0
21	2.05	2.4	2.6	3.6	3.7	3.55	3.1	2.3	1.5	1.5	.0	2.0
22	2.2	2.3	2.8	3.6	3.65	3.45	3.0	2.05	1.6	1.55	.0	2.05
23	2.1	2.0	2.9	3.5	3.65	3.45	3.0	2.1	1.3	1.8	.0	1.95
24	2.1	2.0	3.0	3.6	3.6	3.45	.0	2.0	1.7	1.4	.0	1.25
25	2.15	2.0	3.15	3.65	3.65	3.4	2.95	2.05	1.5	1.2	.0	1.4
26	2.1	.0	3.2	3.7	3.65	3.35	3.0	1.9	1.65	1.3	.0	.9
27	2.2	2.25	3.3	3.7	3.6	3.35	3.1	1.85	1.65	1.6	1.7	2.2
28	2.2	2.35	3.35	3.7	3.6	3.35	3.0	1.7	1.7	1.5	1.95	2.3
29	2.3	.....	3.4	3.7	3.6	3.4	2.95	2.15	2.2	1.45	2.0	2.2
30	1.65	.....	3.6	3.7	3.6	3.45	3.1	1.7	2.25	1.45	1.95	2.3
31	1.8	.....	3.65	.....	3.65	.....	3.05	1.5	.....	1.4	.....	2.2

Station rating table for Stanislaus Water Company's ditch near Knights Ferry, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	2.5	1.70	14	2.40	40	3.10	79
1.10	3.5	1.80	17	2.50	45	3.20	85
1.20	5	1.90	20	2.60	50	3.30	91
1.30	6.5	2.00	24	2.70	55	3.40	97
1.40	8	2.10	28	2.80	61	3.50	104
1.50	10	2.20	32	2.90	67	3.60	111
1.60	12	2.30	36	3.00	73	3.70	118

NOTE.—The above table is based on 9 discharge measurements made during 1905. It is well defined between gage heights 1 foot and 3.7 feet. Monthly estimates are included with those of Stanislaus River, page —.

MISCELLANEOUS MEASUREMENTS IN STANISLAUS RIVER DRAINAGE BASIN.

Stanislaus River at Parrotts Ferry, Cal.—A measurement was made on this stream from the downstream side of the wagon bridge at Parrotts Ferry on September 12, 1905, by H. A. Campbell.

Width, 35 feet; area, 138 square feet; mean velocity, 0.66 foot per second; discharge, 91 second-feet.

South Fork of Stanislaus.—A measurement was made on this stream on September 25, 1905, at trail crossing to Yancey's ranch about 14 miles above its junction with the main river and about 3 miles north of Confidence, Cal. Measurement made by H. A. Campbell.

Width, 5 feet; area, 2.4 square feet; mean velocity, 0.40 foot per second; discharge, 0.96 second-feet.

Middle Fork of Stanislaus.—A measurement was made on this stream on September 26, 1905, at the bridge on the trail to McCormicks, about 5 miles above its junction with the main river. Measurement made by H. A. Campbell.

Width, 21 feet; area, 350 square feet; mean velocity, 0.24 foot per second; discharge, 84 second-feet.

Griswald Creek.—This stream enters Stanislaus River about 2 miles above the mouth of the Middle Fork. A measurement was made on September 26, 1905, at trail crossing, about 5 miles above the mouth, by H. A. Campbell.

Width, 6 feet; area, 5.4 square feet; mean velocity, 0.37 foot; discharge, 2.0 second-feet.

Beaver Creek.—This stream enters Stanislaus River from the east about 5 miles above the mouth of the Middle Fork. A measurement was made on September 26, 1905, at the trail crossing to the Calaveras big trees and about 5 miles above its junction with North Fork of Stanislaus River. Measurement made by H. A. Campbell.

Width, 2.5 feet; area, 2.8 square feet; mean velocity, 1.64 feet per second; discharge, 4.6 second-feet.

North Fork of Stanislaus River at Squaw Hollow, Cal.—A measurement was made about 75 yards upstream from trail bridge at Squaw Hollow on September 27, 1905, by H. A. Campbell.

Width, 29 feet; area, 48 square feet; mean velocity, 1.60 feet per second; discharge, 77 second-feet.

MOKELUMNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Mokelumne River drains an area of 657 square miles of the western slope of the Sierra Nevada. It has numerous tributaries, the North, South, and Middle forks being the most important. This stream heads well back in the main crest of the Sierra Nevada at an elevation of 8,000 feet.

The formation is of granite with good soil covering and heavy timber growth on the middle and higher elevations. On the lower elevations the slopes are less rugged and the soil covering is of brush and scattering oak timber with large areas of cultivated land and pasture. There are numerous small glacial lakes and moraines in the upper reaches of this basin. The precipitation varies from 25 inches on the lower to 50 inches on the higher elevations, where it falls in the form of snow, which melts in the early spring. The greatest discharge usually occurs in April, May, and June. There is some artificial storage in this basin, but not enough to have much effect on the discharge.

Several diversions are made for mining and power purposes within the drainage basin, and this water is returned to the river above the gaging station, which is located at Clement, a few miles above Lodi, Cal.

MOKELUMNE RIVER NEAR CLEMENTS, CAL.

This station was established October 28, 1904, by O. W. Peterson. It is located at the highway bridge, 1 mile north of Clements.

The channel is straight for 150 feet above and 500 feet below the gaging station. The right bank is high and not subject to overflow. The left bank is subject to overflow when the gage reads above 15 feet. The bed of the stream is composed of gravel and is subject to slight changes.

Discharge measurements are made from the downstream side of the bridge. The initial point is on the end of the bridge near the right bank.

The gage is in two sections. The low-water section is an inclined rod nailed to posts driven in the ground, and the high-water section is a vertical rod nailed to a pile and near the inclined rod. Both are on the right bank. During 1905 the gage was read by Allen Gaskill. The bench mark is the head of a bolt driven in a pile, to which the upper section of the gage is fastened; elevation, 9.60 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Mokelumne River near Clements, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 23	F. R. S. Buttemer	132	293	2.69	5.15	788
January 24	do	128	258	2.40	4.85	620
January 24	do	128	250	2.38	4.79	596
January 30	do	121	191	2.01	4.28	384
February 9	do	126	259	2.39	4.87	620
February 15	do	122	193	2.27	4.31	438
February 20	do	210	562	2.54	6.14	1,425
May 18	W. B. Clapp	248	1,238	3.06	9.00	3,788
June 29	O. W. Peterson	130	237	2.36	4.64	559
July 28	Peterson and Lee	60	80	1.56	3.14	125
September 5	C. H. Lee	58	79	1.27	3.13	100
November 29	do	55	66	.86	2.90	57

Daily gage height, in feet, of Mokelumne River near Clements, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.0	4.85	5.4	6.05	7.5	7.65	4.3	3.2	3.3	3.4	3.25	3.25
2	4.55	7.55	5.45	6.2	7.0	7.45	4.3	3.3	3.3	3.25	3.2	3.1
3	4.5	5.8	5.5	6.3	6.9	7.15	4.1	3.3	3.25	3.3	3.25	3.1
4	4.4	5.35	5.65	6.45	6.65	6.9	4.0	3.3	3.3	3.25	3.1	3.0
5	4.15	6.55	5.6	6.7	6.5	6.6	3.85	3.2	3.3	3.3	3.1	2.95
6	4.3	5.7	5.7	6.8	6.4	6.8	3.85	3.25	3.3	3.3	3.1	2.95
7	4.1	5.3	5.5	6.95	6.6	7.1	3.8	3.15	3.3	3.45	3.1	3.1
8	4.1	5.0	5.6	7.05	6.9	7.05	4.05	3.3	3.35	3.4	2.95	3.1
9	4.3	4.9	5.45	6.85	6.55	7.0	3.65	3.25	3.3	3.25	3.0	3.05
10	4.3	4.65	5.45	7.0	6.4	7.15	3.6	3.3	3.3	3.35	2.95	3.05
11	4.1	4.65	5.5	6.6	6.3	7.55	3.7	3.2	3.2	3.3	2.95	3.0
12	4.1	4.55	5.45	6.25	6.3	7.75	3.6	3.3	3.3	3.35	2.95	3.1
13	4.15	4.5	6.1	6.25	6.25	7.75	3.65	3.2	3.3	3.35	2.9	3.05
14	4.15	4.55	6.15	6.45	6.2	7.1	3.45	2.9	3.35	3.15	2.95	3.1
15	4.2	4.35	5.55	6.6	7.4	6.95	3.45	3.35	3.35	3.15	2.85	3.05
16	4.7	4.4	5.6	6.75	8.25	6.85	3.35	3.3	3.3	3.25	2.85	3.05
17	4.3	4.95	6.2	6.35	10.55	6.65	3.3	3.3	3.3	3.25	2.8	3.1
18	4.25	4.9	6.55	6.9	9.0	6.5	3.3	3.35	3.35	3.05	2.8	3.15
19	4.35	4.85	7.05	6.8	8.85	6.25	3.3	3.4	3.35	3.2	2.85	3.15
20	4.4	5.8	7.3	6.35	8.8	6.15	3.3	3.25	3.35	3.1	2.9	3.2
21	4.45	5.5	6.85	6.05	8.85	6.0	3.3	3.25	3.35	3.05	3.05	3.3
22	4.45	5.25	6.65	6.05	8.25	5.75	3.3	3.25	3.4	3.0	2.85	3.35
23	5.0	5.15	6.3	6.25	7.9	5.45	3.3	3.25	3.35	2.9	2.9	3.3
24	4.85	5.1	6.55	6.7	8.65	5.35	3.3	3.25	3.4	2.95	2.95	3.2
25	4.6	5.25	6.5	7.25	8.6	4.9	3.3	3.3	3.3	3.1	2.85	3.0
26	4.55	5.45	6.3	7.6	8.95	5.1	3.25	3.35	3.35	3.0	2.85	2.95
27	4.45	5.55	6.9	8.3	7.35	4.9	3.2	3.35	3.35	3.2	3.2	3.05
28	4.2	5.35	6.45	8.3	7.1	4.75	3.2	3.3	3.35	3.15	3.25	3.1
29	4.25	.....	6.85	8.4	7.45	4.65	3.15	3.25	3.35	3.0	3.3	3.1
30	4.3	.....	6.4	8.15	7.45	4.4	3.15	3.3	3.45	3.05	3.15	3.1
31	4.35	.....	6.2	.....	7.6	.....	3.2	3.35	.....	3.15	.....	3.15

Station rating table for Mokelumne River near Clements, Cal., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	78	4.30	391	5.60	1,059	6.90	2,000
3.10	96	4.40	427	5.70	1,124	7.00	2,080
3.20	115	4.50	465	5.80	1,191	7.20	2,240
3.30	134	4.60	506	5.90	1,260	7.40	2,400
3.40	154	4.70	550	6.00	1,330	7.60	2,560
3.50	174	4.80	597	6.10	1,400	7.80	2,730
3.60	195	4.90	647	6.20	1,475	8.00	2,900
3.70	218	5.00	700	6.30	1,550	8.20	3,070
3.80	242	5.10	755	6.40	1,625	8.40	3,250
3.90	268	5.20	812	6.50	1,700	8.60	3,430
4.00	295	5.30	871	6.60	1,775	8.80	3,610
4.10	325	5.40	932	6.70	1,850	9.00	3,800
4.20	357	5.50	995	6.80	1,925		

NOTE.—The above table is based on 12 discharge measurements made during 1905. It is well defined between gage heights 2.9 feet and 6.2 feet. The table has been extended beyond these limits, being based on 1 measurement at 9 feet gage height.

Estimated monthly discharge of Mokelumne River near Clements, Calif., for 1905.

[Drainage area, 642 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-feet per sq. mile.	Depth in inches.
January	700	325	428	26,320	.667	.769
February	2,520	409	853	47,370	1.33	1.38
March	2,320	932	1,410	86,700	2.20	2.54
April	3,250	1,365	1,959	116,600	3.05	3.40
May	5,260	1,475	2,547	156,600	3.97	4.58
June	2,688	427	1,665	99,070	2.59	2.89
July	391	106	188	11,560	.293	.338
August	154	60	128	7,870	.199	.229
September	164	115	139	8,271	.217	.242
October	164	60	114	7,010	.178	.205
November	134	43	794	4,725	.124	.138
December	144	69	970	5,964	.151	.174
The year	5,260	43	801	578,100	1.25	16.88

NORTHERN PACIFIC OCEAN DRAINAGE BASIN.

RUSSIAN RIVER DRAINAGE BASIN.

MISCELLANEOUS MEASUREMENTS.

The following is a list of miscellaneous discharge measurements made in Russian River drainage basin during 1905:

Russian River at Calpella, Cal.—A measurement of this stream was made on September 21, 1905, one-fourth mile east of Calpella and about 3 miles above mouth of East Fork of Russian River by R. S. Hawley.

Width, 6 feet; area, 1.6 square feet; mean velocity, 0.75 foot per second; discharge, 1.2 second-feet.

East Fork of Russian River near Ukiah, Cal.—A measurement of this stream was made September 21, 1905, one-fourth mile above its junction with Russian River by R. S. Hawley.

Width, 10 feet; area, 4.6 square feet; mean velocity, 0.48 foot per second; discharge, 2.2 second-feet.

Russian River at Preston, Cal.—A measurement of this stream was made September 22, 1905, 1 mile above Preston, Cal., by R. S. Hawley.

Width, 23 feet; area, 9.8 square feet; mean velocity, 1.05 feet per second; discharge, 10.3 second-feet.

EEL RIVER DRAINAGE BASIN.

MISCELLANEOUS MEASUREMENTS.

The following is a list of miscellaneous discharge measurements made in Eel River drainage basin during 1905:

South Eel River at Hearst, Cal.—This stream is tributary to the Eel River from the south. A measurement was made 600 feet below the Hearst bridge on September 19, 1905, by R. S. Hawley.

Width, 20 feet; area, 7.6 square feet; mean velocity, 1.25 feet per second; discharge, 9.5 second-feet.

Middle Eel River at Covelo, Cal.—A measurement of this stream was made September 19, 1905, at the road crossing between Willets and Covelo about 7 miles above its junction with South Eel by R. S. Hawley.

Width, 34 feet; area, 12.2 square feet; mean velocity, 0.57 foot per second; discharge, 7.0 second-feet.

Middle Eel River at Laytonville, Cal.—A measurement of this stream was made September 20, 1905, 50 feet above its junction with South Eel River by R. S. Hawley.

Width, 18 feet; area, 22 square feet; mean velocity, 0.36 foot per second; discharge, 8.0 second-feet.

Eel River at Laytonville, Cal.—A measurement of this stream was made September 20, 1905, 50 feet below the junction of Middle and South Eel rivers by R. S. Hawley.

Width, 20 feet; area, 16 square feet; mean velocity, 1.69 feet per second; discharge, 27 second-feet.

South Eel River at Laytonville, Cal.—From the difference of the measurement made below the junction of the Middle and South Eel and that made on Middle Eel above on September 20, 1905, the discharge of South Eel at the junction is 19.2 second-feet.

KLAMATH RIVER DRAINAGE BASIN.

LINK RIVER AT KLAMATH FALLS, OREG.[a]

This station was established May 15, 1904, by J. H. Lewis. It is located at the county bridge at Klamath Falls, Oreg., 1½ miles below the outlet of Klamath Lake.

The channel is straight for 400 feet above and below the station. The current is swift; the fall in the 1½ miles between the lake and the gaging station is about 70 feet. The right bank is low and wooded, but not liable to overflow. The left bank is high and rocky. The bed of the stream is composed of gravel, free from vegetation, and subject to some change. There is but one channel at all stages. One irrigation ditch takes water from the river on the left bank about three-fourths mile above the station. Driftwood from a sawmill above the station collects around the bridge piers and interferes materially with the accuracy of measurements. A short distance below the gaging station the river discharges into a lake of considerable size. At flood stages the velocity is checked by water backing up from the lake below, which has a tendency to give decreased velocities with high gage readings. Gage heights may be affected by wind piling up the water of the upper and lower lakes.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the first vertical rod supporting the floor beam at the left end of the bridge, upstream side.

A staff gage is fastened vertically to the plank bracing between steel caissons near the left bank. During 1905 the gage was read once each day by G. H. Woodbury. Bench marks were established as follows: (1) A 30-penny nail driven into the floor beam over the gage; elevation, 12.50 feet. (2) The center of a cross cut in the first sandstone above the ground in the southwest corner of the foundation of the Linkville Hotel; elevation, 15.88 feet. Elevations refer to the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

[a] This station was known as Klamath River at Klamath Falls, Oreg., in report for 1904.

Discharge measurements of Link River at Klamath Falls, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 4	C. T. Darley	282	1,571	1.82	4.05	2,862
January 17	do	282	1,570	1.76	4.10	2,768
January 17	do	282	1,571	1.83	4.10	2,872
January 17	do	282	1,571	1.67	4.10	2,627
February 1	do	287	1,660	2.01	4.30	3,338
February 13	do	288	1,683	1.78	4.50	2,994
February 17	do	288	1,648	1.70	4.40	2,802
March 2	do	288	1,642	1.82	4.40	2,984
April 12	do	290	1,733	2.10	4.49	3,645
June 5	do	279	1,494	1.56	3.88	2,324
June 20	do	277	1,410	1.28	3.59	1,800
June 28	do	283	1,354	1.12	3.40	1,517
July 11	do	297	1,280	1.15	3.14	1,466
July 18	do	272	1,234	.86	2.97	1,063
July 28	do	270	1,178	.89	2.80	1,049
August 7	do	267	1,162	.90	2.63	1,041
August 14	do	267	1,146	.93	2.59	1,066
August 16	W. B. Clapp and C. T. Darley	267	1,187	.93	2.60	1,104
September 7	C. T. Darley	267	1,141	.90	2.58	1,032
September 16	do	268	1,155	.93	2.58	1,073
November 2	do	272	1,254	1.02	2.90	1,283

Daily gage height, in feet, of Link River at Klamath Falls, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	4.2	4.4	4.5	4.2	3.95	3.45	2.79	2.6	2.7	2.81	3.25
2	4.1	4.4	4.4	4.5	4.2	3.85	3.45	2.75	2.6	2.65	2.8	3.3
3	4.1	4.4	4.4	4.5	4.2	3.85	3.3	2.7	2.58	2.7	2.81	3.29
4	4.1	4.4	4.4	4.5	4.2	3.9	[a] 3.3	2.67	2.6	2.7	2.84	3.2
5	4.1	4.5	4.4	4.5	4.2	3.88	3.25	2.67	2.58	2.9	2.82	3.2
6	4.1	4.5	4.4	4.5	4.2	3.88	3.3	2.67	2.6	2.9	2.88	3.2
7	4.1	4.4	4.4	4.5	4.2	3.81	3.2	2.5	2.58	2.95	2.86	3.21
8	4.1	4.4	4.4	4.5	4.2	3.88	3.2	2.63	2.58	2.7	2.99	3.23
9	4.1	4.4	4.4	4.5	4.2	3.85	[a] 3.25	2.6	2.58	2.9	2.99	3.24
10	4.1	4.5	4.4	4.5	4.2	3.8	3.25	2.6	2.62	2.8	2.98	3.28
11	4.1	4.5	4.4	4.5	4.2	3.8	[a] 3.25	2.59	2.63	2.75	2.99	3.25
12	4.1	4.5	4.4	4.5	4.2	3.78	[a] 3.2	2.6	2.58	2.8	2.9	3.28
13	4.1	4.5	4.4	4.5	4.2	3.75	3.2	2.6	2.58	2.8	2.95	3.27
14	4.1	4.5	4.4	4.5	4.2	3.7	3.1	2.59	2.6	2.8	2.95	3.24
15	4.1	4.5	4.4	4.5	4.1	3.6	3.05	2.6	2.6	2.7	2.95	3.34
16	4.1	4.5	4.4	4.5	4.1	3.7	[a] 3.0	2.6	2.55	2.8	2.9	3.26
17	4.1	4.4	4.4	4.5	4.1	3.62	2.9	2.60	2.5	2.8	2.9	3.33
18	4.1	4.4	4.4	4.45	4.05	[a] 3.61	2.9	2.63	2.55	2.8	2.9	3.32
19	4.1	4.4	4.4	4.4	4.05	3.6	3.0	2.6	2.6	2.8	3.2	3.32
20	4.1	4.4	4.4	4.4	4.05	3.59	2.9	2.6	2.6	2.85	3.1	3.26
21	4.1	4.4	4.4	4.35	4.0	[a] 3.55	2.9	2.6	2.6	2.85	3.3	3.27
22	4.1	4.4	4.4	4.35	4.0	3.5	2.95	2.6	2.58	2.79	3.2	3.33
23	4.1	4.4	4.4	4.35	4.0	3.5	2.85	2.6	2.6	2.8	3.15	3.3
24	4.2	4.4	4.4	4.3	4.0	3.5	2.85	2.6	2.68	2.85	3.1	3.32
25	4.2	4.4	4.4	4.3	4.0	3.4	[a] 2.85	2.6	2.55	2.81	3.2	3.29
26	4.2	4.4	4.4	4.3	4.0	3.4	[a] 2.85	2.7	2.58	2.8	3.25	3.35
27	4.2	4.4	4.4	4.3	4.0	3.4	[a] 2.8	2.8	2.6	2.89	3.15	3.36
28	4.1	4.4	4.5	4.25	4.0	3.4	[a] 2.8	2.6	2.62	2.88	3.15	3.33
29	4.2	.....	4.6	4.25	4.0	3.4	2.78	2.6	2.65	2.88	3.4	3.4
30	4.2	.....	4.5	4.25	3.95	3.35	2.79	2.65	2.65	2.81	3.2	3.53
31	4.2	.....	4.5	.....	3.95	.....	2.78	2.55	.....	2.9	.....	3.53

[a] Estimated.

Station rating table for Link River at Klamath Falls, Oreg., from May 15, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	985	3.60	1,920	4.70	3,580	5.80	5,790
2.60	1,035	3.70	2,045	4.80	3,770	5.90	6,020
2.70	1,090	3.80	2,175	4.90	3,960	6.00	6,250
2.80	1,150	3.90	2,310	5.00	4,150	6.20	6,710
2.90	1,220	4.00	2,450	5.10	4,340	6.40	7,180
3.00	1,300	4.10	2,590	5.20	4,530	6.60	7,660
3.10	1,390	4.20	2,740	5.30	4,730	6.80	8,140
3.20	1,485	4.30	2,900	5.40	4,930	7.00	8,640
3.30	1,585	4.40	3,060	5.50	5,140	7.20	9,140
3.40	1,690	4.50	3,230	5.60	5,350		
3.50	1,800	4.60	3,400	5.70	5,570		

NOTE.—The above table is applicable only for open-channel conditions. It is based on twenty-eight discharge measurements made during 1904-5. It is not very well defined.

Estimated monthly discharge of Link River at Klamath Falls, Oreg., for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean	
1904.				
May 15-31	9,015	8,140	8,640	291,300
June	8,140	5,245	6,740	401,100
July	5,140	3,060	4,123	253,500
August	2,980	1,860	2,336	143,600
September	1,800	1,535	1,662	98,900
October	1,745	1,585	1,686	103,700
November	1,982	1,745	1,837	109,300
December	2,520	1,860	2,185	134,400
The period				1,536,000
1905.				
January	2,740	2,590	2,624	161,300
February	3,230	2,740	3,103	172,300
March	3,400	3,060	3,087	189,800
April	3,230	2,820	3,106	184,800
May	2,740	2,380	2,597	159,700
June	2,380	1,638	2,004	119,200
July	1,745	1,138	1,363	83,810
August	1,144	985	1,051	64,620
September	1,062	985	1,033	61,290
October	1,260	1,062	1,159	71,260
November	1,690	1,150	1,330	79,140
December	1,860	1,485	1,587	100,800
The year	3,400	985	2,004	1,448,000

KLAMATH RIVER AT KENO, OREG.

This station was established August 13, 1904, by T. H. Humphreys. It is located one-fourth mile below the county bridge at Keno, Oreg.

The channel is straight for one-fourth mile above and below the station. The current is sluggish at low and moderate at high stages. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of bowlders. An up or down stream wind piles up the water near the gage on account of the low velocities.

Discharge measurements are made by means of a cable and car one-fourth mile downstream from the bridge. The initial point for soundings is at the cable support on the right bank.

A staff gage is fastened vertically to the downstream side of the second bent from the left end of the bridge. During 1905 the gage was read once each day by S. Padgett. Bench marks were established as follows: (1) The top of projecting cap of bridge bent to which the gage is nailed; elevation, 16.80 feet. (2) A 60-penny nail driven into the south gatepost on the west side of the road 58 feet from the south end of the bridge; elevation, 18.85 feet. Elevations refer to the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Klamath River at Keno, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 10	C. T. Darley	407	3,800	0.68	13.00	2,590
January 23	do	420	3,794	.77	13.30	2,930
January 30	do	420	3,804	.76	13.20	2,875
February 9	do	425	3,700	.80	13.25	2,975
February 18	do	428	3,838	.83	13.30	3,192
March 3	do	432	3,850	.82	13.30	3,145
March 31	do	425	3,828	.83	13.32	3,179
April 13	do	425	3,760	.80	13.28	3,015
May 17	do	427	3,687	.73	13.03	2,676
June 19	do	410	3,545	.59	12.68	2,102
July 14	do	407	3,348	.43	12.80	1,445
August 14	do	402	3,129	.37	11.80	1,146
August 31	do	404	3,221	.29	11.75	924
November 3	do	409	3,325	.20	12.00	680
December 3	do	410	3,390	.25	12.28	851

Daily gage height, in feet, of Klamath River at Keno, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.9	13.2	13.3	13.4	13.2	13.0	12.5	11.9	11.8	11.9	12.1	12.3
2	12.9	13.2	13.3	13.4	13.2	13.0	12.4	11.9	11.8	11.9	12.1	12.3
3	13.0	13.3	13.3	13.4	13.2	13.0	12.4	11.9	11.8	11.9	12.1	12.3
4	13.0	13.3	13.3	13.4	13.2	13.0	12.4	11.9	11.8	11.9	12.1	12.3
5	13.0	13.3	13.3	13.4	13.2	13.0	12.4	11.9	11.8	11.9	12.1	12.3
6	13.0	13.3	13.3	13.4	13.2	12.9	12.3	11.8	11.8	11.9	12.1	12.3
7	13.0	13.3	13.3	13.4	13.2	12.9	12.3	11.8	11.8	11.9	12.1	12.3
8	13.1	13.3	13.3	13.4	13.1	12.9	12.2	11.8	11.8	11.9	12.1	12.4
9	13.1	13.3	13.3	13.4	13.1	12.9	12.2	11.8	11.8	11.9	12.1	12.4
10	13.1	13.3	13.3	13.4	13.1	12.9	12.2	11.8	11.8	11.9	12.1	12.4
11	13.1	13.3	13.3	13.4	13.1	12.9	12.2	11.8	11.8	11.9	12.1	12.4
12	13.1	13.3	13.3	13.3	13.1	12.8	12.2	11.8	11.8	11.9	12.1	12.4
13	13.1	13.3	13.2	13.3	13.1	12.8	12.2	11.8	11.8	11.9	12.1	12.4
14	13.1	13.3	13.2	13.3	13.1	12.8	12.2	11.8	11.8	11.9	12.1	12.4
15	13.1	13.3	13.2	13.3	13.1	12.7	12.2	11.8	11.8	11.9	12.1	12.4
16	13.1	13.3	13.2	13.3	13.1	12.7	12.2	11.8	11.8	11.9	12.2	12.4
17	13.1	13.3	13.2	13.3	13.0	12.7	12.2	11.8	11.8	12.0	12.2	12.4
18	13.1	13.3	13.2	13.3	13.0	12.7	12.2	11.8	11.8	12.0	12.2	12.4
19	13.1	13.3	13.2	13.2	13.0	12.6	12.1	11.8	11.8	12.0	12.2	12.4
20	13.1	13.3	13.2	13.2	13.0	12.6	12.1	11.8	11.8	12.0	12.2	12.4
21	13.1	13.3	13.2	13.2	13.0	12.6	12.1	11.8	11.8	12.0	12.3	12.4
22	13.1	13.3	13.2	13.2	13.0	12.5	12.1	11.8	11.8	12.0	12.3	12.4
23	13.3	13.3	13.2	13.2	13.0	12.5	12.1	11.8	11.8	12.0	12.3	12.4
24	13.1	13.3	13.2	13.2	13.0	12.5	12.1	11.8	11.8	12.0	12.3	12.4
25	13.1	13.3	13.3	13.2	13.0	12.5	12.0	11.8	11.8	12.0	12.3	12.4
26	13.1	13.3	13.3	13.2	13.0	12.5	12.0	11.8	11.8	12.0	12.3	12.4
27	13.1	13.3	13.3	13.2	13.0	12.5	12.0	11.8	11.8	12.0	12.3	12.5
28	13.2	13.3	13.4	13.2	13.0	12.5	12.0	11.8	11.8	12.1	12.3	12.5
29	13.2	.....	13.4	13.2	13.0	12.5	12.0	11.8	11.9	12.1	12.3	12.5
30	13.2	.....	13.4	13.2	13.0	12.5	12.0	11.8	11.9	12.1	12.3	12.5
31	13.2	.....	13.4	.....	13.0	.....	11.9	11.8	.....	12.1	.....	12.5

Station rating table for Klamath River at Keno, Oreg., from May 31, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
11.60	900	12.60	1,960	13.60	3,730	14.60	6,590
11.70	970	12.70	2,100	13.70	3,960	14.70	6,940
11.80	1,050	12.80	2,250	13.80	4,200	14.80	7,300
11.90	1,140	12.90	2,400	13.90	4,460	14.90	7,670
12.00	1,240	13.00	2,560	14.00	4,730	15.00	8,050
12.10	1,350	13.10	2,730	14.10	5,010	15.10	8,440
12.20	1,460	13.20	2,910	14.20	5,300	15.20	8,840
12.30	1,580	13.30	3,100	14.30	5,600	15.30	9,250
12.40	1,700	13.40	3,300	14.40	5,920		
12.50	1,830	13.50	3,510	14.50	6,250		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1904-5. It is well defined between gage heights 12.2 feet and 13.3 feet.

Estimated monthly discharge of Klamath River at Keno, Oreg., for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
June	8,440	5,300	7,076	421,100
July	5,300	3,300	4,177	256,800
August	3,100	2,100	2,513	154,500
September	2,100	1,700	1,778	105,800
October	1,830	1,700	1,775	109,100
November	2,100	1,960	2,007	119,400
December	2,400	2,100	2,235	137,400
The period				1,304,000
1905.				
January	3,100	2,400	2,716	167,000
February	3,100	2,910	3,086	171,400
March	3,300	2,910	3,052	187,700
April	3,300	2,910	3,097	184,300
May	2,910	2,560	2,688	165,300
June	2,560	1,830	2,157	128,400
July	1,830	1,140	1,436	88,300
August	1,140	1,050	1,065	65,480
September	1,140	1,050	1,056	62,840
October	1,350	1,140	1,203	73,970
November	1,580	1,350	1,445	85,980
December	1,830	1,580	1,694	104,200
The year	3,300	1,050	2,058	1,485,000

SYCAN RIVER NEAR SILVERLAKE, OREG.

This station was established May 2, 1905, by Ivan Landes. It is located about 30 miles south of Silverlake, Oreg., in sec. 19, T. 32 S., R. 14 E.

The channel is straight for about 20 feet above and 150 feet below the station. The current is swift. The right bank is high, rocky, and clean and does not overflow. The left bank is low, clean, and subject to overflow at extreme high stages. The bed of the stream is of rocks, gravel, and sand, free from vegetation, and permanent. There is but one channel at low and two channels at high stages.

Discharge measurements are made from a private bridge. The initial point for soundings is at the west end of the bridge.

A staff gage is fastened vertically to a bent of the bridge. During 1905 the gage was read by O. F. Griffith and J. S. Wakefield. The bench mark is a marked point of rock on the right bank a short distance upstream from the bridge; elevation, 6.79 feet above the datum of the gage.

Discharge measurements of Sycan River near Silverlake, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
March 16	Ivan Landes	21	28	1.38	2.40	38
April 10	do	30	46	2.36	3.05	110
May 2	do	56	93	1.76	3.45	163
June 12	do	52	44	1.56	2.32	69
July 30	Landes and King	19	11.9	.86	1.27	10.2
October 3	Ivan Landes	14	14.9	.36	1.70	5.4
November 7	do	12	7.1	.85	1.12	6.0

Daily gage height, in feet, of Sycan River, near Silverlake, Oreg., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.6	1.8	1.25	1.4	.....	17	3.5	2.15	1.45	1.0	1.75	1.8
2	3.45	2.6	1.8	1.25	1.4	1.7	18	3.4	2.05	1.45	1.05	1.8	1.8
3	3.35	2.6	1.75	1.1	1.5	1.85	19	3.3	2.2	[a]1.3	1.05	1.8	1.7
4	3.25	3.0	1.75	1.15	1.5	1.7	20	3.4	2.1	1.35	1.1	1.75	1.85
5	3.2	3.1	1.7	.8	1.55	1.85	21	2.9	2.0	1.4	1.1	1.75	1.7
6	3.2	3.1	1.7	.8	1.55	1.8	22	3.0	1.8	1.4	1.15	1.75	1.7
7	3.25	3.2	1.7	.8	1.55	2.0	23	3.1	1.9	1.4	1.15	1.75	1.85
8	3.6	3.0	1.6	.8	1.55	1.9	24	3.0	1.9	1.4	1.2	1.75	1.85
9	3.4	3.0	1.6	.8	1.6	1.8	25	2.9	1.9	1.3	1.25	1.75	1.85
10	3.35	[a]2.5	1.5	.8	1.65	1.7	26	3.2	1.95	1.25	1.25	1.75	1.85
11	3.35	2.4	1.5	.8	1.7	1.7	27	3.55	1.9	1.25	1.3	2.0	1.85
12	3.3	2.3	1.5	.8	1.7	1.8	28	3.1	1.9	1.25	1.3	1.9	1.7
13	3.4	2.4	1.5	.8	1.75	1.7	29	2.9	1.85	1.25	1.35	1.8	.....
14	3.25	2.6	1.5	1.0	1.75	1.7	30	2.8	1.85	1.25	1.35	1.8	.....
15	3.3	2.4	1.5	1.0	1.75	1.65	31	2.7	.....	1.25	1.4	1.8	.....
16	3.35	2.2	1.5	1.0	1.75	1.8							

[a] Water turned into ditch.

LOST RIVER NEAR CLEAR LAKE, CAL.

This station was established September 1, 1904, by T. H. Humphreys. It is located about 2 miles downstream from Jessie D. Carr's Clear Lake dam, a short distance below the dam site for Clear Lake reservoir, about 20 miles from Tule Lake post-office, Cal.

The channel is straight for about 150 feet above and below the station. The current is swift. Both banks are high, rocky, and clean. There is a flood plain about 150 feet in width along the left bank. The bed of the stream is composed of rock, gravel, and soil. The channel contains a considerable growth of tules during the spring and summer months.

Discharge measurements are made during flood stages by means of a cable and car, and at low stages by wading. The initial point for soundings is the left-bank end of the cable.

A gage is painted on the vertical rock cliff on the right bank. November 4, 1905, an automatic water-height register was installed for recording gage heights. The bench mark is a mark on the rock to which the left end of the cable is anchored; elevation, 16.62 feet above the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Lost River near Clear Lake, Cal., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 26	C. T. Darley	102	92	1.75	6.30	161
February 3	do	130	196	2.31	7.20	453
February 7	do	100	104	2.08	6.39	216
February 24	do	98	70	1.77	6.01	124
March 7	do	102	102	1.92	6.35	196
March 13	do	110	115	2.19	6.50	252
April 3	do	130	203	2.64	7.30	535
April 8	do	92	85	2.05	6.24	174
April 28	do	14	12.8	1.88	5.26	24
June 2	do	9.5	8.8	.90	5.00	7.9
September 11	do	10	8.8	.66	5.02	5.8
October 30	do	16	10.1	.75	5.10	7.6

Daily gage height, in feet, of Lost River near Clear Lake, Cal., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	7.3	6.3	6.0	5.3	5.0	.....	.....	.....	.....	5.1	5.15
2	5.4	7.8	6.2	7.5	5.3	5.0	.....	.....	.....	.....	5.1	5.15
3	5.4	7.3	6.3	7.2	5.2	5.05	.....	.....	.....	.....	5.1	5.2
4	5.4	7.1	6.3	6.9	5.2	5.1	.....	.....	.....	.....	5.1	5.2
5	5.4	6.8	6.4	6.7	5.1	5.15	.....	.....	.....	.....	5.1	5.2
6	5.4	6.5	6.3	6.6	5.1	5.2	.....	.....	.....	.....	5.1	5.2
7	5.4	6.3	6.5	6.4	5.15	5.35	.....	.....	.....	.....	5.1	5.2
8	5.4	6.1	6.4	6.2	5.2	5.6	.....	.....	.....	.....	5.1	5.15
9	5.4	5.8	6.3	6.0	5.2	5.9	.....	.....	.....	.....	5.1	5.15
10	5.4	5.6	6.2	5.8	5.2	5.8	.....	.....	.....	.....	5.1	5.15
11	5.4	5.2	6.2	5.7	5.3	5.7	.....	.....	.....	.....	5.1	5.15
12	5.4	6.05	6.3	5.8	5.4	5.6	.....	.....	.....	.....	5.1	5.15
13	5.4	6.95	6.5	5.7	5.35	5.4	.....	.....	.....	.....	5.1	5.15
14	5.6	6.9	6.2	5.5	5.3	5.25	.....	.....	.....	.....	5.1	5.15
15	5.8	6.7	6.1	5.5	5.25	5.1	.....	.....	.....	.....	5.1	5.15
16	6.0	6.2	6.3	5.55	5.2	5.0	.....	.....	.....	.....	5.1	5.2
17	6.25	5.6	6.9	5.6	5.15	5.0	.....	.....	.....	.....	5.1	5.2
18	6.3	5.5	6.7	5.6	5.1	5.0	.....	.....	.....	.....	5.1	5.2
19	6.3	5.8	6.3	5.7	5.05	5.0	.....	.....	.....	.....	5.1	5.2
20	6.3	6.4	6.4	5.5	5.05	5.0	.....	.....	.....	.....	5.2	5.2
21	6.35	6.3	6.6	5.5	5.0	5.0	.....	.....	.....	.....	5.15	5.2
22	6.4	6.2	6.9	5.5	5.0	5.0	.....	.....	.....	.....	5.15	5.2
23	6.4	6.0	6.9	5.45	5.0	5.0	.....	.....	.....	.....	5.15	5.2
24	6.45	6.1	6.5	5.4	4.95	5.0	.....	.....	.....	.....	5.15	5.2
25	6.5	6.2	6.3	5.4	4.9	5.0	.....	.....	.....	.....	5.15	5.2
26	6.3	6.0	6.5	5.5	4.9	5.0	.....	.....	.....	.....	5.2	5.2
27	6.0	6.1	6.9	5.4	4.95	5.0	.....	.....	.....	.....	5.2	5.2
28	6.2	6.2	6.6	5.3	5.0	5.0	.....	.....	.....	.....	5.2	5.2
29	6.4	.....	6.7	5.3	5.05	5.0	.....	.....	.....	5.1	5.15	5.2
30	6.6	.....	6.0	5.3	5.1	5.0	.....	.....	.....	5.1	5.15	5.2
31	6.8	.....	6.4	.....	5.05	.....	.....	.....	.....	5.1	.....	5.2

Station rating table for Lost River near Clear Lake, Cal., from September 4, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.90	6	5.70	66	6.50	238	7.30	508
5.00	9	5.80	81	6.60	268	7.40	545
5.10	12	5.90	98	6.70	300	7.50	582
5.20	17	6.00	117	6.80	332	7.60	619
5.30	23	6.10	138	6.90	365	7.70	657
5.40	31	6.20	160	7.00	400	7.80	695
5.50	41	6.30	184	7.10	436	7.90	733
5.60	53	6.40	210	7.20	472	8.00	772

NOTE.—The above table is based on 16 discharge measurements made during 1904-5. It is fairly well defined.

Estimated monthly discharge of Lost River near Clear Lake, Cal., for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
September	20	9	11.3	673
October	23	12	18.1	1,113
November	17	12	15.5	923
December	27	14	18.2	1,119
1905.				
January	332	31	120	7,379
February	695	17	217	12,050
March	365	117	224	13,770
April	582	23	127	7,557
May	31	6	14.6	898
June	98	9	21.6	1,286
July			[a] 7.0	430
August			[a] 6.0	369
September			[a] 7.0	417
October			[a] 10.0	615
November	17	12	13.0	774
December	12	14	16.0	984
The year			65.3	46,530

[a] Estimated.

LOST RIVER NEAR MERRILL, OREG.

This station was established July 26, 1904, by T. H. Humphreys. It is located about 1½ miles downstream from the Stukel Bridge, 4 miles northwest of Merrill, Oreg.

The channel is straight for 200 feet above and 400 feet below the station. The current is swift at high and medium at low stages. Both banks are high and not liable to overflow. The bed of the stream is composed of clay, rock, and gravel, and is not subject to change. There is but one channel at all stages. During low water the flow over the greater portion of the section is shallow and broken, making it difficult to obtain accurate results with a current meter. Near the right bank the channel is deeper. At low water in the fall of the year a considerable growth of water grass accumulates in the channel. An old rock dam located 200 feet above the gaging station does not materially interfere with the accuracy of discharge measurements.

Discharge measurements are made at flood stages by means of a cable and car and at low water by wading. The initial point for soundings is the stream face of the left-bank cable support.

A staff gage is fastened vertically at the left bank about 40 feet upstream from the cable. During 1905 the gage was read by Mrs. Joseph Stukel. Bench marks were established as follows: (1) A large wire nail driven into post supporting cable at left bank; elevation, 17.92 feet. (2) A nail driven into the sill at the northwest corner of a granary 200 feet downstream from the cable on the right bank; elevation, 20.61 feet. Elevations refer to the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Lost River near Merrill, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft per sec.*	*Feet.*	*Sec.-ft.*
January 18	C. T. Darley	87	82	1.60	3.50	131
February 1	do	102	208	2.72	4.80	566
February 8	do	108	240	2.74	5.05	658
February 27	do	92	197	2.70	4.55	533
March 5	do	96	199	2.71	4.63	540
April 5	do	120	425	2.67	6.77	1,134
April 14	do	90	140	2.03	4.00	284
April 29	do	80	95	1.53	3.50	145
May 12	do	89	95	1.37	3.50	130
June 14	do	89	86	1.36	3.41	117
July 23	do	90	86	1.36	3.45	117
August 15	C. T. Darley and W. B. Clapp	88	82	1.26	3.41	103
August 26	C. T. Darley	87	84	1.21	3.31	102
September 15	do	87	83	1.22	3.32	101

Daily gage height, in feet, of Lost River near Merrill, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	4.7	4.5	4.8	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
2	3.5	5.7	4.5	4.8	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
3	3.5	6.3	4.5	6.0	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
4	3.5	6.8	4.5	7.0	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
5	3.5	7.0	4.6	6.8	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
6	3.5	6.2	4.6	6.0	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
7	3.5	5.6	4.6	5.3	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
8	3.5	5.1	4.55	5.4	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
9	3.5	4.7	4.55	5.6	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
10	3.5	4.4	4.4	5.8	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
11	3.5	4.2	4.3	5.9	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
12	3.5	4.0	4.35	4.0	3.5	3.55	3.4	3.4	3.3	3.3	3.3	3.3
13	3.5	3.9	4.2	4.0	3.5	3.55	3.4	3.4	3.3	3.3	3.3	3.3
14	3.5	3.8	4.2	4.0	3.5	3.55	3.4	3.4	3.3	3.3	3.3	3.3
15	3.5	3.8	4.2	4.0	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
16	3.5	3.7	4.1	3.9	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
17	3.5	3.7	4.1	3.9	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
18	3.5	3.7	4.1	3.8	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
19	3.5	3.7	4.1	3.8	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
20	3.5	3.8	4.2	3.8	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
21	3.5	3.8	4.4	3.7	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
22	3.5	3.9	4.5	3.7	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
23	3.5	4.4	4.6	3.7	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
24	3.5	4.4	4.7	3.6	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
25	4.5	4.5	4.9	3.6	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
26	5.4	4.5	4.6	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
27	5.3	4.55	4.6	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
28	5.0	4.55	5.0	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
29	4.7	.....	4.9	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
30	4.5	.....	4.8	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
31	4.4	.....	4.8	.....	3.5	.....	3.4	3.4	.....	3.3	.....	3.3

Station rating table for Lost River near Merrill, Oreg., from July 16, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.30	102	3.60	176	3.90	262	4.20	362
3.40	125	3.70	203	4.00	294		
3.50	150	3.80	232	4.10	328		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1904-5. It is not well defined. Above gage height 4.2 feet the rating curve is a tangent, the difference being 35 per tenth

Estimated monthly discharge of Lost River near Merrill, Oreg., for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
July 26-31	203	203	203	2,415
August	203	176	199	12,240
September	176	163	165	9,818
October	163	150	158	9,715
November	150	150	150	8,925
December	150	150	150	9,223
The period				52,330
1905.				
January	782	150	248	15,250
February	1,342	203	514	28,550
March	642	328	461	28,350
April	1,342	150	470	27,970
May	150	150	150	9,223
June	163	125	138	8,212
July	125	125	125	7,686
August	125	125	125	7,686
September	102	102	102	6,069
October	102	102	102	6,272
November	102	102	102	6,069
December	102	102	102	6,272
The year	1,342	102	220	157,600

TULE LAKE NEAR MERRILL, OREG.

This station was established May 17, 1904, by John H. Lewis and Ivan Landes for recording the water level in Tule Lake. It is located on Tule Lake at the mouth of Lost River about 3 miles east of Merrill, Oreg , 25 miles south from Klamath Falls, and near the Oregon-California line.

The gage is a vertical timber fastened to posts driven in the lake bed, about 20 feet from the shore of the lake. It is in line with the east lane fence, one-fourth mile south of the residence of J. Frank Adams. The bench mark is a notch cut in large juniper gatepost on the north side of the gate entrance about 60 feet distant from the gage rod; elevation, 13.70 feet above the zero of the gage.

Daily gage height, in feet, of Tule Lake near Merrill, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1												
2				9.25								
3						9.05	8.6					
4					9.2							
5												
6			9.1									
7								7.95				
8										7.05	6.85	6.85
9									7.4			
10						9.0	8.5					
11												
12		8.9										
13	8.6											
14								7.8	7.3			
15			9.15									6.7
16					9.15					7.0	6.8	
17							8.4					
18		8.9										
19						8.95						
20												
21								7.6				
22									7.2			
23				9.2	9.1					6.9	6.8	
24			9.1				8.3					
25												
26												6.6
27		9.0				8.7						
28												
29												
30									7.1	6.95	6.8	
31	8.65						8.05	7.5				6.55

NOTE.—Ice out of river, Jan. 31.

MILLER CREEK NEAR LORELLA, OREG.

This station was established August 10, 1904, by F. S. Chapman. It is located at Horsefly, 10 miles northeast of Lorella, Oreg.

The channel is straight for 600 feet above and 100 feet below the station. The current is sluggish at low and swift at high stages. Both banks are high, rocky, wooded, and not subject to overflow. The bed of the stream is of rock and gravel, and not liable to change. The channel is obstructed by much vegetation during the season of low stage.

Discharge measurements are made during high stages by means of a cable and car, and at low stages by wading. The initial point for soundings is the stream side of the cable support on the right bank.

A staff gage is fastened vertically at the right bank, 300 feet upstream from the cable, where the water stands in a pool. During 1905 the gage was read by Louis Gerber. On December 9, 1905, an automatic water-height register was installed for recording gage heights. The bench mark is a point on top of a large bowlder 25 feet downstream from the gage; elevation, 12.68 feet above the datum of the gage.

Gage heights and discharge measurements taken at this station during 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

Discharge measurements of Miller Creek near Lorella, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
January 28	C. T. Darley	110	72	2.03	7.25	146
February 4	do	124	86	1.87	7.30	161
February 6	do	90	58	1.50	6.99	87
February 25	do	118	88	2.01	7.30	177
March 8	do	91	72	1.72	7.14	124
March 15	F. S. Chapman	90	65	1.46	6.92	95
April 2	C. T. Darley	130	155	2.97	8.00	460
April 9	do	72	47	1.32	6.88	62
April 28	do	18	10.8	.29	6.19	3.1
June 1	do	20	11.2	.18	6.11	2.0

Daily gage height, in feet, of Miller Creek near Lorella, Oreg., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.3	8.0	7.2	7.0	6.3	6.2						
2	6.3	8.2	7.2	8.0	6.3	6.1						
3	6.3	7.7	7.3	7.8	6.3	6.1						
4	6.3	7.3	7.3	7.6	6.3	6.2						
5	6.3	7.7	7.3	7.4	6.3	6.2						
6	6.3	7.0	7.2	7.2	6.3	6.3						
7	6.3	7.0	7.2	7.0	6.2	6.3						
8	6.3	7.0	7.2	6.9	6.2	6.3						
9	6.3	7.0	7.1	6.8	6.4	6.3						[a] 6.0
10	6.3	6.9	7.1	6.8	6.4	6.3						6.0
11	6.3	6.6	7.0	6.8	6.4	6.3						6.0
12	6.3	6.5	7.1	6.6	6.4	6.3						6.0
13	6.3	6.5	7.1	6.6	6.4	6.2						6.0
14	6.3	6.4	7.1	6.5	6.4	6.2						6.0
15	6.3	6.4	6.8	6.5	6.3	6.2						6.0
16	7.5	6.4	7.3	6.6	6.3	6.2						6.0
17	7.6	6.4	7.3	6.6	6.3							6.0
18	7.7	6.4	7.3	6.6	6.3							6.0
19	7.5	6.8	7.4	6.5	6.3							6.0
20	7.5	7.2	7.4	6.5	6.2							6.0
21	7.5	7.3	7.1	6.5	6.1							6.0
22	7.9	7.3	7.3	6.4	6.0							6.0
23	8.2	7.3	7.3	6.4	6.0							6.0
24	7.9	7.3	7.2	6.4	6.0						6.0	6.0
25	7.9	7.3	7.2	6.3	5.9						6.1	6.0
26	7.7	7.3	7.9	6.3	6.1							6.0
27	7.7	7.3	7.5	6.2	6.1							6.0
28	7.3	7.3	7.4	6.2	6.2							6.0
29	7.5		7.4	6.2	6.3							6.0
30	8.0		7.2	6.2	6.2							6.0
31	8.3		7.2		6.2							

[a] New gage.

NOTE.—No flow June 17 to December 31.

Station rating table for Miller Creek near Lorella, Oreg., from August 7, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	0	6.80	52	7.60	274	8.40	665
6.10	1.5	6.90	67	7.70	317	8.50	717
6.20	4	7.00	86	7.80	363	8.60	770
6.30	8	7.10	109	7.90	411	8.70	823
6.40	13	7.20	135	8.00	460	8.80	876
6.50	20	7.30	163	8.10	510	8.90	929
6.60	29	7.40	196	8.20	561	9.00	982
6.70	39	7.50	234	8.30	613		

NOTE.—The above table is based on 13 discharge measurements made during 1904-5. It is well defined between gage heights 6.1 feet and 8 feet.

Estimated monthly discharge of Miller Creek near Lorella, Oreg., for 1904 and 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
August	1.5	.75	1.3	79
September	1.5	.0	.2	12
October	8	1.5	2.4	148
November	8	1.5	3.7	221
December	10.5	1.5	6.2	381
The period				841
1905.				
January	613	8	179	11,010
February	561	13	138	7,664
March	411	52	153	9,408
April	460	4	71.0	4,225
May	13	0	6.5	400
June	8	0	3.0	179
July	0	0	.0	0
August	0	0	.0	0
September	0	0	.0	0
October	0	0	.0	0
November	0	0	.0	0
December	0	0	.0	0
The year	613	0	46.	32,890

PRECIPITATION AND EVAPORATION DATA.

The following table gives the total precipitation in inches, by months, and also the annual totals:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Keno, Oreg.:													
1904	.....	.....	.....	.....	.....	.....	.....	0.00	1.58	2.08	1.50	3.57	.....
1905	2.08	1.91	2.30	0.66	2.29	0.15	0.06	0.00	0.75	0.72	1.30	2.23	14.79
Tule Lake, Cal.:													
1904	.....	.....	.....	.....	.....	.....	.....	0.00	0.92	1.01	0.42	3.11	.....
1905	1.25	1.19	1.70	0.20	2.62	0.30	0.00	0.00	0.42	.....	1.25	0.93	.....
Horse Fly, near Lorella, Oreg.:													
1904	.....	.....	.....	.....	.....	.....	.....	0.00	0.71	1.11	1.07	2.61	.....
1905	1.43	1.09	2.22	0.28	2.56	1.23	0.00	0.00	0.32	0.32	0.83	2.41	12.69

The following table gives the total evaporation in inches, by months, at Keno, Oreg.:

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1904	.....	.....	.....	.....	.....	.....	.....	6.66	5.12	2.01	2.01	2.01	.....
1905	1.19	0.78	0.78	2.69	4.12	6.20	7.57	7.03	6.15	1.98	0.46	.....	.....

MISCELLANEOUS MEASUREMENTS IN NORTHERN PACIFIC OCEAN DRAINAGE BASIN.

Antelope Creek near Mount Hebron, Cal.—This creek rises on the eastern slope of Mount Shasta. It is tributary to Lower Klamath Lake, although its waters sink before reaching the lake. A measurement was made June 17 by C. T. Darley, 12 miles below its source.

Width, 25.5 feet; area, 37 square feet; mean velocity, 3.03 feet per second; discharge, 112 second-feet.

Another measurement was made August 28 by C. T. Darley 15 miles below its source.

Width, 13 feet; area, 9.4 square feet; mean velocity, 1.11 feet per second; discharge, 10.4 second-feet.

Adams ditch near Merrill, Oreg.—This canal diverts water from White Lake, an arm of Lower Klamath Lake. For the first mile this canal is common with the Van Brimmer canal. It is about 16 miles in length and is used for the irrigation of land in the vicinity of Merrill, Oreg. The following measurements were made during 1905 at a point one mile below the head of the canal and 300 feet below the point where the Adams and Van Brimmer canals separate. The gage rod is a 1 by 4 inch timber divided into feet and hundredths. There is no bench mark.

May 14: Width, 36 feet; area, 42 square feet; mean velocity, 1.10 feet per second; gage height, 1.73 feet; discharge, 46 second-feet.

May 21: Width, 37.6 feet; area, 47 square feet; mean velocity, 1.13 feet per second; gage height, 1.90 feet; discharge, 53 second-feet.

June 15: Width, 37.5 feet; area, 40 square feet; mean velocity, 1.28 feet per second; gage height, 2.14 feet; discharge, 51 second-feet.

July 22: Width, 37.5 feet; area, 43 square feet; mean velocity, 1.19 feet per second; gage height, 2.22 feet; discharge, 51 second-feet.

August 24: Width, 37.5 feet; area, 36 square feet; mean velocity, 1.03 feet per second; gage height, 2.13 feet; discharge, 37 second-feet.

August 25: Width, 36.7 feet; area, 32 square feet; mean velocity, 0.91 foot per second; gage height, 2.00 feet; area, 29 second-feet.

August 25: Width, 37.9 feet; area, 39 square feet: mean velocity, 1.05 feet per second; gage height, 2.26 feet: discharge, 41 second-feet.

Ankeny ditch, station No. 1, near Klamath Falls, Oreg.—Ankeny canal diverts water from Link River at the outlet of Upper Klamath Lake, 1½ miles above the town of Klamath Falls, Oreg. The water from this canal is used for electric power and irrigation purposes in the vicinity of Klamath Falls. This station is located about 500 feet above point of diversion to electric power plant. Discharges here given represent the amount of water used for both electric power and irrigation purposes. The following measurements were made during 1905 by C. T. Darley.:

June 29: Width, 17.4 feet; area, 21 square feet; mean velocity, 2.71 feet per second; gage height, 1.36 feet; discharge, 57 second-feet.

June 30: Width, 17.4 feet; area, 20 square feet; mean velocity, 2.70 feet per second; gage height, 1.34 feet; discharge, 54 second feet.

May 11: Width, 17.5 feet; area, 22 square feet; mean velocity, 2.86 feet per second; gage height, 1.39 feet; discharge, 63 second-feet.

June 29: Width, 17.4 feet; area, 21 square feet; mean velocity, 2.52 feet per second; gage height, 1.36 feet; discharge, 53 second-feet.

Ankeny canal station No. 2, near Klamath Falls, Oreg.—This station is located about 200 feet below point of diversion by electric power plant. Discharges here given represent the amount of water used for irrigation purposes.

April 23: Width, 13.5 feet; area, 7.0 square feet; mean velocity, 1.24 feet per second; gage height, 1.28 feet; discharge, 8.7 second-feet.

May 2: Width, 13.5 feet; area, 13.1 square feet; mean velocity, 2.21 feet per second; gage height, 1.68 feet; discharge, 29 second-feet.

May 11: Width, 13.5 feet; area, 15 square feet; mean velocity, 2.33 feet per second; gage height, 1.80 feet; discharge, 35 second-feet.

Butte Creek near Mount Hebron, Cal.—Butte Creek rises on the eastern slope of Mount Shasta. It is tributary to Lower Klamath Lake and its waters sink in Butte Valley before reaching the lake. This creek discharges over fissured lava and large quantities of water are lost by seepage. That portion which reaches Butte Valley is used for irrigation. The following measurements were made during 1905 by C. T. Darley, 1½ miles above Boyce ranch at county road crossing.

May 5: Width, 15.5 feet; area, 51 square feet; mean velocity, 1.33 feet per second; gage height, 3.77 feet; discharge, 68 second-feet.

May 19: Width, 15.9 feet; area, 51 square feet; mean velocity, 1.47 feet per second; gage height, 3.95 feet; discharge, 75 second-feet.

June 16: Width, 16 feet; area, 48 square feet; mean velocity, 1.08 feet per second; gage height, 3.72 feet; discharge, 52 second-feet.

August 29: Width, 14 feet; area, 35 square feet; mean velocity, 0.47 foot per second; gage height, 3.00 feet; discharge, 16.4 second-feet.

November 23: Width, 14 feet; area, 36 square feet; mean velocity, 0.23 foot per second; gage height, 3.30 feet; discharge, 8.1 second-feet.

Bowne's west canal, near Bonanza, Oreg. -This canal takes water from Lost River, the water being raised by means of pumps and used for irrigation in the vicinity of Bonanza, Oreg. A measurement was made on May 31 by C. T. Darley at a point 300 feet below head of flume.

Width, 9.5 feet; area, 5.9 square feet; mean velocity, 1.46 feet per second; discharge, 8.6 second-feet.

Boards ditch, Poe Valley, Oreg.—This ditch diverts water from Lost River. The water is raised by means of a water wheel and is used for irrigation in the vicinity of Olene, Oreg. A measurement was made on July 19 by C. T. Darley at a point 300 feet below head of canal.

Width, 2 feet; area, 1.56 square feet; mean velocity, 0.22 foot per second; discharge, 0.3 second-foot.

Coyote Creek, Oreg.—Coyote Creek is tributary to Sycan marsh. During 1905 discharge measurements were made by Ivan Landes as follows:

March 15: Width, 5.5 feet; area, 4.7 square feet; mean velocity, 0.89 foot per second; discharge, 4.2 second-feet.

April 10: Width, 6.0 feet; area, 6.1 square feet; mean velocity, 1.34 feet per second; discharge, 8.2 second-feet.

May 2: Width, 6.0 feet; area, 5.6 square feet; mean velocity, 1.05 feet per second; discharge, 5.9 second-feet.

June 12: Width, 5.0 feet; area, 3.4 square feet; mean velocity, 0.50 foot per second; discharge, 1.7 second-feet.

July 31: Width, 1.4 feet; area, 0.4 square foot; mean velocity, 1.38 feet per second; discharge, 0.6 second-foot.

Crooked Creek near Klamath Agency, Oreg.—This stream is a tributary of Wood River. A measurement was made May 27 by C. T. Darley at the bridge 1½ miles from Klamath Agency, on road to Fort Klamath.

Width, 24.8 feet; area, 88 square feet; mean velocity, 0.52 foot per second; discharge, 46 second-feet.

Cherry Creek near Crystal, Oreg.—This stream is tributary to Upper Klamath Lake from the west. A measurement was made on May 25 by C. T. Darley at road crossing between Pelican Bay and Fort Klamath.

Width, 27 feet; area, 25 square feet; mean velocity, 1.28 feet per second; discharge, 32 second-feet.

Crane Creek near Fort Klamath, Oreg.—Crane Creek is a tributary to Seven Mile Creek. A measurement was made on May 25 by C. T. Darley at the bridge on wagon road between Fort Klamath and Pelican Bay, Oreg.

Width, 11.5 feet; area, 20 square feet; mean velocity, 0.54 foot per second; discharge, 10.7 second-feet.

Cottonwood Creek near Brownell, Cal.—Cottonwood Creek is tributary to Lower Klamath Lake from the South. The following measurements were made during 1905, 1 mile below its source, at "F" ranch, Brownell:

June 15: Width, 19.5 feet; area, 41 square feet; mean velocity, 0.25 foot per second; discharge, 10.2 second-feet.

August 30: Width, 27.5 feet; area, 24 square feet; mean velocity, 0.53 foot per second; discharge, 12.6 second-feet.

Doris Creek near Picard, Cal.—Doris Creek is tributary to Lower Klamath Lake from the southwest. A measurement was made on June 18 by C. T. Darley at the Doris ranch.

Width, 5.4 feet; area, 4.9 square feet; mean velocity, 1.24 feet per second; discharge, 6.1 second-feet.

Dirty Creek, Oregon.—Dirty Creek is tributary to Sycan marsh. During 1905 discharge measurements were made by Ivan Landes, as follows:

March 15: Width, 3.0 feet; area, 1.4 square feet; mean velocity, 0.98 foot per second; discharge, 1.4 second-feet.

April 10: Width, 3.0 feet; area, 1.5 square feet; mean velocity, 0.99 foot per second; discharge, 1.3 second-feet.

May 2: Width, 3.0 feet; area, 1.4 square feet; mean velocity, 1.0 foot per second; discharge, 1.4 second-feet.

Edson Foulks ditch.—This ditch is in Shasta Valley. A measurement was made at head of ditch September 3, 1905, by L. G. Applegate.

Width, 6.3 feet; area, 6.3 square feet; mean velocity, 1.75 feet per second; discharge, 11 second-feet.

Four Mile Creek, Pelican Bay, Oregon.—Four Mile Creek is tributary to Upper Klamath Lake from the west. Its source is in Four Mile Lake. A measurement was made May 24 by C. T. Darley at road crossing between Klamath Falls and Pelican Bay.

Width, 50.5 feet; area, 75 square feet; mean velocity, 0.70 foot per second; discharge, 53 second-feet.

Grass Valley Creek near Lowden, Cal.—Grass Valley Creek is tributary to Trinity River. A measurement was made of this stream August 26, 1905, by W. B. Clapp at lower wagon bridge on Buckhorn road 2½ miles above junction of creek with Trinity River.

Width, 19 feet; area, 18.7 square feet; mean velocity, 0.98 foot per second; discharge, 18.4 second-feet.

Griffith canal near Olene, Oreg.—This canal diverts water from Lost River. The water is raised by means of a water wheel and used for irrigation of land in the vicinity of Olene. The following measurements were made during 1905 by C. T. Darley at head of canal:

June 2: Width, 2 feet; area, 1.4 square feet; mean velocity, 1.29 feet per second; discharge, 1.8 second-feet.

June 13: Width, 2 feet; area, 1.5 square feet; mean velocity, 1.27 feet per second; discharge, 1.9 second-feet.

June 25: Width, 2 feet; area, 1.16 square feet; mean velocity, 1.08 feet per second; discharge, 1.3 second-feet.

Hot Springs Creek near Klamath Falls, Oreg.—Hot Springs Creek rises about one-half mile east of Klamath Falls and discharges into Lower Klamath Lake. A measurement was made on August 18 by C. T. Darley near point where creek crosses county road east of Klamath Falls, Oreg.

Width, 1.5 feet; area, 0.36 square foot; mean velocity, 0.94 foot per second; discharge, 4.4 second-feet.

Horton ditch at Poe Valley, Oreg.—This ditch diverts water from Lost River, which is used for irrigation on the south side of the river. A measurement was made on June 23 by C. T. Darley at a point one-fourth of a mile below head of ditch.

Width, 7.5 feet; area, 7.4 square feet; mean velocity, 0.59 foot per second; discharge, 4.4 second-feet.

Little Shasta River at Little Shasta, Cal.—A measurement of this stream was made August 29, 1905, by M. D. Williams.

Width, 9 feet; area, 5.4 square feet; mean velocity, 0.70 foot per second; discharge, 3.8 second-feet.

Little Shasta Springs at Little Shasta, Cal.—A measurement was made August 29, 1905, by M. D. Williams.

Width, 9 feet; area, 5.6 square feet; mean velocity, 3.57 feet per second; discharge, 20 second-feet.

Long Creek, Oreg.—Long Creek is tributary to Sycan Marsh. During 1905 discharge measurements were made by Ivan Landes as follows:

March 15: Width, 22 feet; area, 21.8 square feet; mean velocity, 1.54 feet per second; discharge, 33.6 second-feet.

April 10: Width, 25 feet; area, 36.9 square feet; mean velocity, 1.48 feet per second; discharge, 54.6 second-feet.

May 1: Width, 26 feet; area, 46.8 square feet; mean velocity, 1.45 feet per second; discharge, 68.1 second-feet.

June 12: Width, 25 feet; area, 37.6 square feet; mean velocity, 1.56 feet per second; discharge, 58.6 second-feet.

July 31: Width, 20 feet; area, 10.8 square feet; mean velocity, 1.72 feet per second; discharge, 18.6 second-feet.

Moss Creek near Pelican Bay, Oregon.—Moss Creek is tributary to Upper Klamath Lake from the west. A measurement was made on May 23 by C. T. Darley at road crossing between Pelican Bay and Klamath Falls, Oreg.

Width, 5.5 feet; area, 3.3 square feet; mean velocity, 0.76 foot per second; discharge, 2.5 second-feet.

McCormick mill-race canal near Keno, Oreg.—This canal diverts water from Klamath River about 1 mile below Keno, Oreg. This water is used for power purposes in running a

sawmill. The following measurements were made during 1905 by C. T. Darley at a point one-fourth of a mile below head of canal:

June 19: Width, 17 feet; area, 43 square feet; mean velocity, 1.51 feet per second; discharge, 64 second-feet.

August 31: Width, 14.5 feet; area, 25 square feet; mean velocity, 2.12 feet per second; discharge, 53 second-feet.

Moore's power canal near Klamath Falls, Oreg.—This canal diverts water from the head of Link River and is used for power purposes in running a sawmill. The following measurement was made by C. T. Darley at a point one-half mile below head of canal:

March 25: Width, 9.9 feet; area, 34 square feet; mean velocity, 3.03 feet per second; discharge, 103 second-feet.

At a point 200 feet above Penstock the following measurements were made:

March 25: Width, 9 feet; area, 35 square feet; mean velocity, 2.14 feet per second; discharge, 75 second-feet.

June 21: Width, 9.5 feet; area, 34 square feet; mean velocity, 1.74 feet per second; discharge, 59 second-feet.

June 21: Width, 9.5 feet; area, 34 square feet; mean velocity, 1.56 feet per second; discharge, 53 second-feet.

Moore's irrigation canal near Klamath Falls, Oreg.—This canal diverts water from the head of Link River at same point at which water is diverted for Moore's mill-race canal on the west bank. This water is used for power purposes in running sawmill and the irrigation of town lots in the west addition of Klamath Falls, Oreg. The following measurements were made during 1905 by C. T. Darley at a point 300 feet below head of canal. These measurements show total amount of water used for power and irrigation purposes in this canal.

March 25: Width, 10 feet; area, 15.8 square feet; mean velocity, 0.82 foot per second; discharge, 12.9 second-feet.

June 21: Width, 12.4 feet; area, 10.1 square feet; mean velocity, 1.08 feet per second; discharge, 10.9 second-feet.

Phillip's wheel canal near Spring Lake, Oregon.—This canal diverts water from Lost River about 9 miles above Merrill, Oreg. The water is raised from the river by means of a water wheel and is used for irrigation purposes. The following measurements were made during 1905 by C. T. Darley at a point in flume 100 feet below point of diversion.

June 13: Width, 3 feet; area, 1.2 square feet; mean velocity, 1.00 foot per second; discharge, 1.2 second-feet.

July 25: Width, 1.2 feet; area, 0.1 square foot; discharge, 0.2 second-foot.

Rock Creek near Aspin Lake, Oregon.—This portion of Rock Creek is tributary to Upper Klamath Lake and has its source in Aspin Lake. A measurement was made on May 23 by C. T. Darley at bridge on wagon road between Klamath Falls and Pelican Bay.

Width, 23.5 feet; area, 16.9 square feet; mean velocity, 0.57 foot per second; discharge, 9.6 second-feet.

Rock Creek at Crystal, Oreg.—This stream is tributary to Crystal Creek and is a separate stream from the Rock Creek which discharges from Aspin Lake. A measurement was made on May 24 by C. T. Darley at bridge on wagon road between Klamath Falls and Pelican Bay.

Width, 19 feet; area, 8.9 square feet; mean velocity, 0.66 foot per second; discharge, 5.9 second-feet.

Scott River near Fort Jones, Cal.—Scott River is tributary to Klamath River. A measurement of this stream was made August 29, 1905, by W. B. Clapp 500 feet above wagon bridge on main road from Fort Jones to Etna, about 1 mile west from Fort Jones.

Width, 27 feet; area, 23 square feet; mean velocity, 1.17 feet per second; discharge, 27 second-feet.

Seven Mile Creek near Fort Klamath, Oreg.—This creek is tributary to Upper Klamath Lake from the north. A measurement was made on May 25 by C. T. Darley at bridge on wagon road between Fort Klamath and Pelican Bay.

Width, 33 feet; area, 129 square feet; mean velocity, 0.79 foot per second; discharge, 102 second-feet.

Shasta River near Yreka, Cal.—Shasta River is tributary to Klamath River. A measurement of this stream was made August 29, 1905, by W. B. Clapp 5 miles northeast of Yreka and 500 feet below diversion dam of the Yreka Light and Power Company.

Width, 11.5 feet; area, 8.2 square feet; mean velocity, 1.22 feet per second; discharge, 10 second-feet.

There was on this date 107 second-feet being diverted into canal 500 feet above this point, giving a total discharge of 117 second-feet for this stream.

Sheepy Creek near Brownell, Cal.—This creek is tributary to Lower Klamath Lake from the southwest. The following measurements were made during 1905 by C. T. Darley at a point 2 miles east of Doris ranch, at wagon bridge near rock ford:

May 18: Width, 78 feet; area, 226 square feet; mean velocity, 0.12 foot per second; discharge, 27 second-feet.

June 18: Width, 80 feet; area, 218 square feet; mean velocity, 0.12 foot per second; discharge, 27 second-feet.

Sprague River near Yainax, Oreg.—Sprague River is tributary to Williamson River. A measurement was made on February 22 by C. T. Darley at bridge 5 miles below Yainax Agency. The gage is a 2 by 8 inch plank graduated to feet and tenths and nailed in a vertical position on the downstream side of the second bent from the south end of the bridge. The bench mark is a 2 by 4 inch stake driven flush with the ground on left bank of the stream in line with upstream side of the bridge and distant 74 feet from end of bridge. The zero of the gage is 21.9 feet below the bench mark.

Width, 133.2 feet; area, 1,077 square feet; mean velocity, 0.55 foot per second; discharge, 589 second-feet; gage height, 14.10 feet.

Spring Creek near Fort Klamath, Oreg.—This creek is tributary to Williamson River from the west. A measurement was made on August 13 by J. B. Lippincott and W. B. Clapp at a point 200 feet above its junction with Williamson River.

Width, 110 feet; area, 195 square feet; mean velocity, 1.86 feet per second; discharge, 362 second-feet.

Swingle flume canal near Lorella, Oreg.—This canal diverts water from Miller Creek above Lorella Bridge. The water is used for irrigation purposes in the vicinity of Lorella. A measurement was made on June 2 by C. T. Darley in small flume at road crossing on Langell Valley and Lorella road.

Width, 2 feet; area, 1.0 square foot; mean velocity, 0.20 foot per second; discharge, 0.2 second-foot.

Three Mile Creek near Fort Klamath, Oreg.—This creek is tributary to Upper Klamath Lake from the northwest. A measurement was made on May 25 by C. T. Darley at crossing of wagon road between Fort Klamath and Pelican Bay.

Width, 13.2 feet; area, 6.2 square feet; mean velocity, 1.00 foot per second; discharge, 6.2 second-feet.

Trinity River near Lowden, Cal.—Trinity River is tributary to Klamath River. A measurement of this stream was made August 26, 1905, by W. B. Clapp from a temporary pontoon bridge 1 mile above Lowden's ranch post-office and 3 miles below Lewiston, Cal. A permanent county highway bridge was being constructed at this point.

Width, 190 feet; area, 468 square feet; mean velocity, 0.50 foot per second; discharge, 233 second-feet.

Varney Creek near Pelican Bay, Oregon.—Varney Creek is tributary to Four Mile Creek. A measurement was made May 24 by C. T. Darley at road crossing between Pelican Bay and Klamath Falls.

Width, 9 feet; area, 13 square feet; mean velocity, 0.70 foot per second; discharge, 9.1 second-feet.

Van Brimmer ditch, south branch, station No. 1, near Merrill, Oreg.—This canal diverts water from White Lake, an arm of Lower Klamath Lake. For the first mile this canal is

common with the Adams canal. This water is used for irrigation in the vicinity of Merrill, Oreg. The following measurements were made on this branch by C. T. Darley during 1905 at point 1 mile below the head of canal and at a point 300 feet below where Adams and Van Brimmer canals become separate and distinct. The gage rod is a 1 by 4 inch inclined timber graduated to feet and hundredths and nailed to posts set firmly in the bank of the canal. There is no bench mark.

May 14: Width, 20 feet; area, 23 square feet; mean velocity, 1.04 feet per second; gage, 4.01 feet; discharge, 24 second-feet.

May 21: Width, 18 feet; area, 17.2 square feet; mean velocity, 1.22 feet per second; gage, 3.78 feet; discharge, 21 second-feet.

June 14: Width, 18.6 feet; area, 16 square feet; mean velocity, 1.28 feet per second; gage, 3.92 feet; discharge, 20 second-feet.

July 22: Width, 18.3 feet; area, 13.9 square feet; mean velocity, 0.83 foot per second; gage, 3.84 feet; discharge, 11.5 second-feet.

August 24: Width, 17.5 feet: area, 10.4 square feet; mean velocity, 0.72 foot per second; gage, 3.72 feet; discharge, 7.5 second-feet.

August 24: Width, 18.2 feet; area, 12.3 square feet; mean velocity, 0.80 foot per second; gage, 3.85 feet; discharge, 9.9 second-feet.

August 25: Width, 19.8 feet; area, 17.9 square feet; mean velocity, 0.91 foot per second; gage, 4.12 feet; discharge, 16.3 second-feet.

August 25: Width, 16.5 feet; area, 5.3 square feet; mean velocity, 0.49 foot per second; gage, 3.40 feet; discharge, 2.6 second-feet.

August 25: Width, 17.0 feet; area, 6.9 square feet; mean velocity, 0.62 foot per second; gage, 3.55 feet; discharge, 4.3 second-feet.

Van Brimmer ditch, north branch, station No. 2, near Merrill, Oreg.—This canal diverts water from White Lake, an arm of Lower Klamath Lake. For the first mile this canal is common with the Adams canal. The following measurements were made of this branch during 1905 by C. T. Darley at a point 1 mile below heading and 300 feet below where Adams and Van Brimmer canals become separate and distinct. The gage is a 1 by 4 inch timber graduated to tenths and half tenths. It is set firmly to posts driven in the ground on the right bank. There is no bench mark.

May 14: Width, 13.8 feet; area, 8 square feet; mean velocity, 0.75 foot per second; gage, 1.95 feet; discharge, 6 second-feet.

May 21: Width, 14.3 feet; area, 7.5 square feet; mean velocity, 0.83 foot per second; gage, 1.99 feet; discharge, 6.2 second-feet.

June 15: Width, 15.4 feet; area, 7.4 square feet; mean velocity, 1.03 feet per second; gage, 2.21 feet; discharge, 7.6 second-feet.

July 24: Width, 16.5 feet; area, 10.4 square feet; mean velocity, 0.93 foot per second; gage, 2.34 feet; discharge 9.7 second-feet.

July 24: Width, 16.5 feet; area, 10.2 square feet; mean velocity, 0.93 foot per second; gage, 2.34 feet; discharge, 9.5 second-feet.

August 24: Width, 15.5 feet; area, 5.6 square feet; mean velocity, 0.79 foot per second; gage, 2.20 feet; discharge, 4.6 second-feet.

Willow Creek near Brownell, Cal.—Willow Creek is tributary to Lower Klamath Lake from the south. The following measurements were made during 1905 at bridge on Merrill and Brownell road by C. T. Darley:

May 20: Width, 20 feet; area, 17.2 square feet; mean velocity, 0.72 foot per second; discharge, 12.5 second-feet.

June 15 Width, 35.5 feet; area, 24 square feet; mean velocity, 0.48 foot per second; discharge, 11.5 second-feet.

August 30: Width, 18 feet; area, 13.9 square feet; mean velocity, 0.70 foot per second; discharge, 9.7 second-feet.

November 23: Width, 10 feet; area, 12.6 square feet; mean velocity, 0.87 foot per second; discharge, 11 second-feet.

Williamson River near Klamath Agency, Oreg.—This stream is tributary to Upper Klamath Lake from the north. The following measurements were made during 1905 at bridge on county road between Klamath Falls and Fort Klamath, Oreg.:

May 27: Width, 175.8 feet; area, 1,532 square feet; mean velocity, 0.89 foot per second; discharge, 1,371 second-feet.

August 22: Width, 176 feet; area, 1,479 square feet; mean velocity, 0.58 foot per second; discharge, 858 second-feet.

At Chillaquin Bridge on road between Klamath Agency and Yainax Agency, November 14: Width, 40 feet; area, 230 square feet; mean velocity, 2.72 feet per second; discharge, 625 second-feet.

Wood River near Fort Klamath, Oreg.—Wood River is tributary to Upper Klamath Lake from the north. The following measurements were made during 1905 by C. T. Darley at bridge on county road, 4 miles below Fort Klamath, Oreg.:

May 27: Width, 52.3 feet; area, 297 square feet; mean velocity, 1.54 feet per second; discharge, 458 second-feet.

At bridge one-fourth mile below Fort Klamath, Oreg.:

August 22: Width, 47.6 feet; area, 166 square feet; mean velocity, 1.60 feet per second; discharge, 266 second-feet.

November 14: Width, 49 feet; area, 162 square feet; mean velocity, 1.59 feet per second; discharge, 259 second-feet.

December 10: Width, 49 feet; area, 162 square feet; mean velocity, 1.69 feet per second; discharge, 274 second-feet.

Yreka Light and Power Company's canal near Yreka, Cal.—A measurement of this canal was made August 29, 1905, by W. B. Clapp from footbridge at house 500 feet below concrete diversion dam at head of canal and distant about 5 miles northeast from Yreka. This canal diverts water from Shasta River.

Width, 17.5 feet; area, 36 square feet; mean velocity, 2.97 feet per second; discharge, 107 second-feet.

For total flow of Shasta River see measurement made same date below diversion dam.

ROGUE RIVER DRAINAGE BASIN.

ROGUE RIVER AT GOLD RAY, OREG.

This station was established August 30, 1905, by L. R. Allen. It is located at Gold Ray, Oreg., 1½ miles below Tolo post-office, just below the Condor Water and Power Company's dam and bridge, and a short distance below the mouth of Stewart Creek.

The channel is straight for 400 feet above and 300 feet below the station. The current at the measuring section is uniform. Both banks are high and rocky and are covered with a light growth of brush. The bed of the stream is rocky, somewhat broken in places, free from vegetation, and permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point is a tag on the tagged wire, 6.2 feet from the cable support on the left bank.

The gage is a vertical staff bolted to concrete pier of bridge about 300 feet above the cable. During 1905 the gage heights were furnished by the Condor Water and Power Company, observations being taken twice each day by C. E. Wertz. The bench mark is the top of the anchor bolt for stay line on the right bank. This bolt is well wedged in solid rock; elevation, 21.34 feet above the datum of the gage.

Discharge measurements of Rogue River at Gold Ray, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
August 30	L. R. Allen	180	1,013	1.29	1.10	1,307
October 17	do	180	1,023	1.18	1.20	1,210
December 26	do	184	1,100	1.38	1.57	1,514

Daily gage height, in feet, of Rogue River at Gold Ray, Oreg., for 1905.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.2	1.2	1.32	17	1.2	1.25	1.22	1.32
2	1.1	1.17	1.2	1.3	18	1.1	1.25	1.3	1.4
3	1.1	1.15	1.2	1.3	19	1.1	1.25	1.3	1.45
4	1.15	1.15	1.2	1.27	20	1.05	1.25	1.5	1.47
5	1.15	1.17	1.2	1.45	21	1.05	1.25	1.3	1.4
6	1.12	1.3	1.2	1.32	22	1.1	1.25	1.25	1.35
7	1.1	1.45	1.2	1.35	23	1.1	1.2	1.25	1.17
8	1.1	1.6	1.2	1.35	24	1.1	1.2	1.22	1.25
9	1.1	1.35	1.2	1.3	25	1.15	1.2	1.2	1.32
10	1.6	1.25	1.2	1.3	26	1.15	1.37	1.2	1.6
11	1.1	1.2	1.2	1.2	27	1.17	1.35	1.3	1.82
12	1.15	1.2	1.2	1.2	28	1.3	1.3	1.3	1.65
13	1.15	1.2	1.2	1.2	29	1.2	1.35	1.4	1.5
14	1.15	1.17	1.2	1.3	30	1.2	1.3	1.3	1.6
15	1.1	1.2	1.2	1.3	31		1.22		1.52
16	1.1	1.22	1.2	1.32					

UMPQUA RIVER DRAINAGE BASIN.

SOUTH FORK OF UMPQUA RIVER NEAR BROCKWAY, OREG.

This station was established December 6, 1905, by L. R. Allen. It is located just below Winston's highway bridge, 3 miles east of Brockway, Oreg., and 3 miles below the mouth of Lookingglass Creek.

The channel is straight for 700 feet above and below the station. The current is uniform, somewhat broken by riffles at low water. Both banks are high, covered with brush, and not liable to overflow. The bed of the stream is of sand and gravel, free from vegetation, and shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a tin tag on the top of the cable support at the right bank.

The gage is a staff in two sections. The lower section is inclined; the upper section is vertical. During 1905 the gage was read once each day by George Brosi. The bench mark is the top of square-headed iron bolt driven into the downstream end of sill of the bridge at the left bank; elevation, 23.31 feet above the datum of the gage.

Discharge measurements of South Fork of Umpqua River near Brockway, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
December 28	L. R. Allen	302	1,616	1.85	4.16	2,998

Daily gage height, in feet, of South Fork of Umpqua River near Brockway, Oreg., for 1905.

Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.
1		8	2.3	15	1.1	22	2.65	29	3.4
2		9	2.1	16	1.05	23	2.2	30	4.35
3		10	1.4	17	1.05	24	1.85	31	6.1
4		11	1.4	18	1.1	25	1.1		
5		12	1.35	19	1.45	26	2.65		
6	1.9	13	1.2	20	3.65	27	4.4		
7	1.9	14	1.15	21	3.3	28	4.1		

NORTH FORK OF UMPQUA RIVER NEAR OAKCREEK, OREG.

This station was established September 6, 1905, by L. R. Allen. It is located 3 miles west of Oakcreek, Oreg., 1¼ miles above J. R. Dixon's farmhouse, about 10 miles below the mouth of East Fork of North Fork of Umpqua River.

The channel is straight for a half mile above and below the station. The current is swift. The right bank is low, covered with brush, and liable to overflow during floods. The left bank is similar, but somewhat higher, and not as apt to overflow. The bed of the stream is of gravel and rock, somewhat broken, free from vegetation, and shifting during floods. There is but one channel at all stages. Measurements may be affected by uncertainties of soundings due to the irregularities of the bed of the stream.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a tag on the tagged wire, 2 feet from the cable support on the right bank.

Two gage rods were installed—one at the place of measurement and the other about 1 mile below. The lower portion of both rods is inclined, and the upper portion is vertical. During 1905 the gage was read once each day by Ethel Dixon. The bench mark at the lower gage is on top of a ¾-inch bolt, driven into sand rock about 50 feet east and 50 feet south of the gage; elevation, 28.47 feet above the datum of the gage.

Discharge measurements of North Fork of Umpqua River near Oakcreek, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
September 6	L. R. Allen	215	457	1.94	1.35	886
October 19	do	222	580	2.45	2.10	1,419
December 27	do	279	1,447	4.91	5.35	7,110

Daily gage height, in feet, of North Fork of Umpqua River near Oakcreek, Oreg., for 1905.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	1.6	1.6	2.6	17	1.3	2.0	1.45	2.6
2	.....	1.5	1.6	3.3	18	1.3	2.2	1.75	2.4
3	.....	1.4	1.55	3.35	19	1.35	2.1	1.9	2.6
4	.....	1.4	1.5	3.7	20	1.35	1.8	2.8	2.7
5	.....	1.4	1.5	3.3	21	1.35	1.65	2.2	3.1
6	1.35	1.8	1.45	3.1	22	1.35	1.7	1.95	2.8
7	1.35	2.3	1.45	3.35	23	1.35	1.65	1.8	2.5
8	1.35	2.85	1.45	3.9	24	1.3	1.6	1.75	2.4
9	1.3	2.1	1.45	3.1	25	1.35	1.75	1.65	2.35
10	1.35	1.75	1.4	3.75	26	1.4	2.75	1.8	6.25
11	1.3	1.65	1.4	2.6	27	1.5	2.3	2.7	5.35
12	1.3	1.55	1.4	2.55	28	1.65	2.0	2.2	4.35
13	1.3	1.5	1.4	2.5	29	1.6	1.8	2.2	3.6
14	1.3	1.45	1.4	2.4	30	1.5	1.7	2.7	4.5
15	1.3	1.65	1.4	2.35	31	.....	1.6	.....	4.3
16	1.3	2.5	1.35	2.3					

SILETZ RIVER DRAINAGE BASIN.

SILETZ RIVER AT SILETZ, OREG.

This station was established November 25, 1905, by L. R. Allen. It is located at Siletz, Oreg., about 1 mile above the ferry on the Siletz and Toledo stage road, 6 miles below the mouth of Rock Creek.

The channel is straight for about 1,000 feet above and 400 feet below the station. The current is swift and rough. Both banks are high and not liable to overflow. The right bank is covered with brush; the left bank is timbered. The bed of the stream is of coarse gravel and sand, free from vegetation, and shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a tin tag on the tagged wire, about 4 feet from the lower end of the turn-buckle on the right bank.

The gage is in two sections on the right bank. The lower section is inclined; the upper is vertical. During 1905 the gage was read once each day by John Kentta. The bench mark is the top of the head of a bolt driven into a large alder tree on the right bank, about 100 feet above the cable; elevation, 18.48 feet above the datum of the gage.

Discharge measurements of Siletz River at Siletz, Oreg., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
November 26	L. R. Allen	157	394	2.95	2.15	1.167

Daily gage height, in feet, of Siletz River at Siletz, Oreg., for 1905.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1	.....	3.75	9	.....	2.9	17	.....	7.8	25	.....	3.2
2	.....	4.2	10	.....	2.6	18	.....	6.0	26	2.1	7.5
3	.....	3.8	11	.....	2.5	19	.....	5.3	27	2.0	5.2
4	.....	3.3	12	.....	2.3	20	.....	5.6	28	2.0	4.3
5	.....	3.0	13	.....	2.2	21	.....	4.9	29	2.7	3.8
6	.....	3.7	14	.....	2.1	22	.....	4.0	30	3.2	4.3
7	.....	3.3	15	.....	2.0	23	.....	3.9	31	.....	5.7
8	.....	3.1	16	.....	2.2	24	.....	3.1			

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 177.]

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

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West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

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